PROMO TT instrument

CNR TECHNOLOGIES CATALOGUE

OF THE “PROMO-TT INSTRUMENT” PROJECT

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SUMMARY

TECHNOLOGIES

LONG NONCODING RNAS CONTAINING ULTRACONSERVED GENOMIC REGION 8 AS PUTATIVE URINARY BIOMARKER FOR BLADDER CANCER DETECTION

 # Record card: 5

Thematic areas

Health & Biotech / Bio-medicals

Health & Biotech / Diagnostic kits

Description

In our recent publication we identified a group of bladder cancer-specific ncRNA, called T-UCRs that are the most up-regulated in bladder cancer patient samples compared with normal bladder urothelium.

Molecular function of the most up-regulated T-UCRs, uc.8+, has been studied in detail in bladder cancer J82 cell line as reported in Olivieri *et al*. 2016. We demonstrated that the expression of uc.8+ was inversely related to BlCa grade, suggesting an early alteration of this lncRNA in the disease pathway of BlCa development. Our preliminary results based on 24 patients and 21 healthy subjects, show that uc.8+ can be detected in patient urine samples and that is up-regulated when compared with normal urines. In particular, uc.8+ levels were significantly higher in patients when compared with normal subjects (Mann-Whitney U test p-value=0.007; Figure 1B). The diagnostic accuracy of uc.8+ was also confirmed by Roc Curve Analysis, which shows an AUC of 0.74 (95% C.I. 0.59 to 0.88).

Type of innovation: Product innovation

Description of innovative features / Competitive advantages

A considerable number of urinary molecular biomarkers have been proposed for bladder cancer diagnostics, including several coding and non-coding RNAs, usually as panels. The novel idea in this project is that of using one particular non-coding RNA which is most strongly expressed in low-grade (i.e. non-muscle-invasive) tumors. Such tumors are not well detected by current assays such as urine cytology or UroVysion which typically rely on properties of high-grade (and therefore also invasive) tumors.

Reference market: Incremental innovation

Development stage: Idea

TRL: 2, 3

Advantages: New product/process/service/technology

Patentable technology: Yes

Patented technology: No

Market positioning: Italian, European, International

Partner required: Enterprise, Public research center/university, Cooperation in national /european/ international project

Key words: Bladder cancer, non-coding RNA, Urinary Biomarker, diagnostic biomarker

Url: *https://promott.cnr.it/en/technology/5/long-noncoding-rnas-containing-ultraconservedgenomic-region-8-as-putative-urinary*

GENOMIC EXPERTISE AND CONSULTANCY TO ACCELERATE USE OF SYNTHETIC GENES AND PLANT RESOURCES

 # Record card: 6

Thematic areas

Agrifood / Agriculture

Agrifood / Nutrition & health

Description

Plants have a huge potential to contribute to the solution of a large number of issues facing the modern world, ranging from a poor crop yields and problems caused by global climate changing. Our team has been on the forefront of the PCR and NGS applications to plant responses to biotic and abiotic stress. As experts in genomics and plant pathology we are able to accelerate the understanding and use of plant genes and resources. As proved by several request of collaborations with either public or private organization and rms, we are prone to support partners from all kinds of agencies, industries in improving their products and processes, gaining approval and improving and implementing the quality of products and contribute to a healthy and sustainable future for the planet.

Type of innovation: Service/know how innovation

Description of innovative features/Competitive advantages

Here we list confidential examples of our support in innovations: **a)** design and production of RNA vaccines against plant pathogens; **b)** study of functional variants of genes involved in resistance/ tolerance to pathogens; **c)** design and production of synthetic genes, such as those including functional motifs; **d)** development of "proof of concepts" in model systems (model plants and yeasts) to accelerate patenting of products or processes; **e)** detection of functional polymorphisms as markers for plant variety characterization; **f)** design of oligonucleotides for the determination of the gene expression level of pathogen resistance genes by PCR; **g)** RNA Recognition of susceptible, resistant and tolerant plant variety responses to biotic and abiotic stresses. The innovative advantages are in the fact of twenty years of working experience in the sector (proven by numerous publications with high impact factor (IF) combined with problem solving approach of the environment and the national agri-food sector and with the availability of innovative platform of elaboration and storage of data (workstations), diagnostics and gene expression (ddPCR, qPCR and PCR, microscopes), image analyzer for gene expression, low temperature (up to -80°C) for RNA storage.

Reference market: Total innovation, Incremental innovation, Impacts on existing markets, Creation of new markets

Development stage: Prototype

TRL: 7

Advantages: Product/process/service/technology optimization

Patented technology: Yes

Country/ies: Europe, Russia, Canada, India

Technology validation/demonstration: Internal validation

Market positioning: Italian, European, International

Partner required: Enterprise, Private research center, Cooperation in national /european / international project

Key words: Synthetic genes, target identi cation, gene reporters design, RNA vaccine against plant patogens, matrix for diagnostics

Url: *https://promott.cnr.it/en/technology/6/genomic-expertise-and-consultancy-to-accellerate-useof-synthetic-genes-and-plant*

INNOVATIVE METHOD FOR UNIFORM SURFACE COVERAGE WITH POROUS MATERIALS

 # Record card: 7

Thematic areas

Materials / Processes of production & treatment of materials
Materials / Photo-active & graphene-based materials
Materials / Semiconductors and Superconductors
Energy and environmental sustainability / Sensory
Energy and environmental sustainability / Renewable sources
ICT & Electronics / Electronics and microelectronics
Energy and environmental sustainability / Energy production, transmission and conversion
Materials / Composite and hybrid materials
ICT & Electronics / Nanotechnologies related to electronics and microelectronics
Energy and environmental sustainability / Pollution treatment (air, soil, water)

Description

Uniform coverage with porous layers over extended surfaces is beneficial for many purposes. Depending on the nature/composition, thickness and interfaces of the layer, this kind of special coverage can assure pivotal properties such as transparency, bendability, high surface reactivity, intermixing capability. In the long list of desired porous materials, transparent oxides find application in the elds of Photovoltaics, Sensing, Photocatalysis, Water Purification and Splitting, Lithium Batteries and many more.

We indeed developed a method to cover large surfaces with porous materials, oxides (e.g. TiO2, Al2O3 etc.) and potentially also nitrides, using a modified reactive sputtering approach called gig-lox. The method is clean since it does not require solvents, reactants or catalytic species. The porous material, that we call sponge, can be confined on small areas or extended on large substrates. Moreover, it can be deposited at any desired thickness, from tens of nanometers to several microns, with properties that can be tuned by eventually doping or heating or modulating the stoichiometry during their growth. The high performances of oxides deposited with our method were already demonstrated by scientific publications wherein the material is integrated in Solar Cells and Sensing Devices. The method can be implemented into production flow-charts on roll-to-roll substrates or bent surfaces of any extension.

Type of innovation: Product innovation, Process innovation

Description of innovative features/Competitive advantages

Porous materials can be hardly deposited by conventional physical deposition methods, that are instead extensively used to grow compact layers with high reproducibility and reliability. Chemical methods are usually preferred to the purpose since they are more versatile and more appropriate to generate sponges. Reliability and reproducibility on large area with chemical growth are, on the other hand, critical issues.

To level the disparity, we developed a new physical method called gig-lox based on a modified reactive sputtering concept to allow large area deposition of porous materials (namely oxides and potentially nitrides) that are contamination-free for high production throughput of devices or to cover extended area of any nature and shape.

The innovation resides in:

1. compositional tunability of the sponge
2. double-scale porosity, in the nanometer scale, through the whole layer thickness
3. thickness tunability, typically in the of thickness 20-1000nm; to be further extended
4. covered area tunability, uniformity over 4 inches wafer assured; to be further extended
5. conformal step coverage
6. use of any kind of substrate

7. multi-parameters conditions: temperature, power loading, anode-cathode distance, gas flow, gas mixture etc.
8. large area production and reliability of the process
9. up-scalable, contamination-free production
10. large surface area availability for functionalization, blending with other materials, small molecules infiltration etc.

Reference market: Incremental innovation, Impacts on existing markets

Development stage: Feasibility

TRL: 4, 5

Advantages: New product/process/service/technology, Product/process/service/technology optimization

Patentable technology: Yes

Patented technology: No

Technology validation/demonstration: Internal validation

Market positioning: International

Partner required: Enterprise, Cooperation in national /european / international project

Key words: advanced materials, porosity, conformal uniform coverage on extended surfaces, cost reduction, high throughput production

Url: *https://promott.cnr.it/en/technology/7/innovative-method-for-uniform-surface-coverage-withporous-materials*

STEREOLITHOGRAPHIC ACTIVE RESIN

 # Record card: 8

Thematic areas

ICT & Electronics / Laser technologies
Bioeconomy
Materials / Photo-active & graphene-based materials
Additive and advanced industrial manufacturing / Additive manufacturing processes and materials
Additive and advanced industrial manufacturing / Factory of the Future
Health & Biotech / Biosensors

Description

Polymer development is approaching to a new stage of advancement in which new functionalities especially in combination with conductive polymers and nanomaterials are more effective. In this context the study of new composites is the key to enable the development of disruptive technologies as additive manufacturing. Increasing electrical conductivity open the way to a new class of objects to be prototyped rapidly at low cost with a high level of customization. Further, the industry has seen a huge increase in the use of additive manufacturing techniques and a development of innovative technologies. The developed technology consists of a new Stereolithographic resin based on the conductive polymer (PEDOT:PSS) and the photocurable resin PEGDA, which has been developed and validated in lab. The composite has been optimized in terms of for what concern conductivity and printability. This resin has been tested to fabricate smart objects as 3D printed electrodes, sensors and transistors.

Type of innovation: Product innovation, Process innovation

Description of innovative features/Competitive advantages

The developed polymer composite for stereolithography is the basis for the development of the next generations techniques for the production of intelligent products, obtained through the use of innovative materials and allowing solutions based on the integration of electronic components (sensors, transducers or actuators), ensuring smart functionality. Additive manufacturing processes (2PP “two-photons polymerization”, FDM “Fused deposition modeling”, SLA “Stereolithography”), combined with high-resolution pick and place technologies, will be able to integrate different sensors and their relative electrical connections, in complex mechanical parts. Reference market: Incremental innovation, Impacts on existing markets

Development stage: Feasibility

TRL: 4

Advantages: New product/process/service/technology

Patentable technology: Yes

Patented technology: No

Market positioning: Italian, European, International

Partner required: Enterprise, Private research center, Cooperation in national /european / international project

Key words: additive manufacturing, rapid prototyping, Composite, Stereolithography, polymer

Url: *https://promott.cnr.it/en/technology/8/stereolithographic-active-resin*

OPTICAL BACKPLANE FOR HIGH CAPACITY AND HIGH-PERFORMANCE ICT APPARATUS, SERVER, DATACENTERS

 # Record card: 9

Thematic areas

ICT & Electronics / Information processing, information system, workflow management ICT & Electronics / Telecommunications

Description

Optical backplane for interconnection between boards of a high-capacity ICT apparatus, datacenter, server and the related automatic assembly method. The solution is based on optical connections between boards with an optimized layout on a support with mechanical constraints that involve controlled deformations of commercial optical fibers with standardized connectors. The entire interconnection circuit is divided into N independent circuits, each of which makes the connections between all the boards (Full-Mesh). The optical fibers remain in the form of ribbon or cable and the optical circuit has a planar development on the backplane or on a parallel plane on it (minimum size). In each sub-circuit, the layout of the optical connectors is regular with Nx2 matrix and the fibers are posed on a support and protection frame. The path of each Tx/Rx connection is generated by an algorithm that optimizes performance and reduces circuit production costs.

Type of innovation: Product innovation

Description of innovative features/Competitive advantages

Optical backplane for high-capacity telecommunications apparatus, datacenters, servers and made with commercial optical fibers (ribbons and cables) and standard connectors. The optical circuit is divided into independent sub-circuits and this gives to the backplane flexibility and advantages in both operation and maintenance. Compared to electric backplanes, it allows highspeed connections and lower energy consumption. Ready for fully optical apparatus. The backplane circuits are encapsulated in support and protection frames designed to ease automated assembly and not critically deform the optical fibers. Advantages: High capacity; High efficiency; Small footprint; Suitable for optical and hybrid equipment; Modular and scalable backplanes; More efficient and economical maintenance; Use of commercial optical fibers and standardized connectors; High IP protection; low energy consumption in operation; Automated assembly and optimized circuit with customized algorithm.

Reference market: Incremental innovation, Impacts on existing markets

Development stage: Prototype

TRL: 6, 7

Advantages: New product/process/service/technology, Cost reduction

Patented technology: Yes

Country/ies: Europe, USA

Technology validation/demonstration: External validation

Market positioning: Italian, European, International

Partner required: Enterprise, Seed capital

Key words: Optical backplane, ICT apparatus, ber optics, data-centers, server

Url: *https://promott.cnr.it/en/technology/9/optical-backplane-for-high-capacity-and-highperformance-ict-apparatus-server*

DEVICE FOR THE MANIPULATION OF MICRO-COMPONENTS

 # Record card: 10

Thematic areas

Additive and advanced industrial manufacturing / Robotics

Additive and advanced industrial manufacturing / Factory of the Future

Additive and advanced industrial manufacturing / Vacuum/High vacuum technologies

Description

The innovative manipulation device - micro-gripper - allows the gripping by vacuum of micro-components and integrates a novel system to support their release. The manipulation of millimetric and sub-millimetric components can present several issues, often negligible at the macro-scale. Indeed, the high surface-to-volume ratio leads to the predominance of the superficial adhesion forces over the gravitational force, therefore the manipulation of micro-parts is very challenging. In particular, the release phase becomes particularly critical, uncertain, and unreliable, since the components often stick to the gripper and the gravitational force does not overcome the adhesion. The micro-gripper conceived enables a controlled release of micro-components and it has been designed to be effective, simple, low-cost, low-weight, easy to use and integrated in a manipulation system.

Type of innovation: Product innovation

Description of innovative features/Competitive advantages

The new vacuum manipulation device uses the same actuating system (a vacuum pump) for grasping the component and controlling an innovative mechanical system to assist the release. The mechanical system, integrated inside the gripper body, can move between two main positions: one of grasping by vacuum and the other of assisted release, as soon as the connection line with the pump is stopped. The innovative device allows the precise, reliable and safe manipulation of micro-parts, avoiding any considerable increase in weight nor excessive complication of the system. The device can be easily mounted on a robot or integrated in a manual or tele-operated manipulation system. Its applications spread across several sectors including electronics, automotive, micro-mechanics, packaging, telecommunication, medicine, biomedicine, and jewelry.

Reference market: Impacts on existing markets

Development stage: Prototype

TRL: 4

Advantages: New product/process/service/technology

Patented technology: Yes

Country/ies: Italy, UK, Switzerland, France, Germany

Technology validation/demonstration: Internal validation

Market positioning: Italian, European

Partner required: Enterprise, Cooperation in national /european / international project

Key words: vacuum micro-gripper, micro-manipulation, micro-handling, assisted release, microcomponent

Url: *https://promott.cnr.it/en/technology/10/device-for-the-manipulation-of-micro-components*

MIST DEPOSITION REACTOR

 # Record card: 11

Thematic areas

Chemicals & Physics / Inorganic substances
Materials / Ceramic materials
Materials / Semiconductors and Superconductors
Materials / Glass
Materials / Optical materials

Description

Chemical solution deposition of metal-organic precursors have favoured the research and development of thin films of simple and complex oxides such as Pb(Zr,Ti)O3, and Al2O3, up to their industrial application in pyroelectric and capacitor devices. Deposition methods used are spin-on and dip-coating. The advantages of the techniques are:

i) low cost of equipment and chemicals
ii) large area deposition
iii) low crystallization temperatures

A mist deposition system takes the solution of the different precursors into the gas phase from a single pot in contact with a transducer, unlike MOCVD for which individual temperature-controlled bubblers with respective heated gas lines and mass ow controllers are needed. It retains all the advantages above but also has the advantages of:

i) film thickness control
ii) deposition above ambient temperatures
iii) conformal coatings on non-planar substrates

Type of innovation: Process innovation, Product / process innovation in integration with an already existing technology

Description of innovative features/Competitive advantages

The system developed at IMEM uses a transducer to generate from the precursor solution a mist that is injected into the reaction chamber by a transport gas. At high frequencies the mist is very ne and hence more reactive than that would be obtained from lower frequency transducers.
The prototype system has been at low cost because of its simplicity and materials used.
The particular advantages of this apparatus are:

i) efficient coupling between transducer and metal-organic solution
ii) protection of the transducer from corrosion by the solution and cleaning
iii) easily applicable to other compositions or reaction configurations.

Further added value comes from the know-how to synthesize of solutions that can generate a mist.

Reference market: Incremental innovation, Impacts on existing markets

Development stage: Feasibility

TRL: 3

Advantages: Product/process/service/technology optimization, Cost reduction

Patentable technology: Yes

Patented technology: No

Publication of technology: No

Technology validation/demonstration: Internal validation

Market positioning: Italian, International

Partner required: Enterprise, Public research center/university, Seed capital, Cooperation in national /european / international project

Key words: Mist deposition, thin lm, oxides, reaction chamber

Url: *https://promott.cnr.it/en/technology/11/mist-deposition-reactor*

ADVANCED SSR (SUPER SPATIAL RESOLUTION) SPECT - PHASE-CONTRAST CT FOR PRECLINICAL IMAGING

 # Record card: 12

Thematic areas

Health & Biotech / Bio-medicals

Health & Biotech / Medical imaging & equipment

Health & Biotech / Diagnostic, Medical imaging & advanced bioimaging

Description

Current standard SPECTs, in order to achieve high resolutions, use a multi-pinholes technology that requires numerous data processing to limit the effects of image distortion. The proposed SSRSPECT scanner, uses a parallel-hole collimator and therefore does not require numerical reprocessing of the data to obtain correct information on the images, while assuring spatial resolutions close to those of the pinholes through the acquisition of sequences of images shifted from one to another. The technique is adaptable to experimental needs, allowing the quality of the images to be optimised according to the specifications of the examination required (by varying the number of images acquired). In addition, the introduction of CT phase contrast improves the morphological details that can be obtained. Thanks to the implementation of phase contrast, it will be possible to obtain a detailed description of biological tissues and the vascular system to be obtained without using external contrast agents.

Type of innovation: Product / process innovation in integration with an already existing technology

Description of innovative features/Competitive advantages

Using patented technology (SSR - Super Spatial Resolution), it is possible to estimate an improvement of between 35-70% in nominal spatial resolution, compared to standard SPECT technology. The introduction of CT phase contrast improves the morphological details that can be obtained. With the implementation of phase contrast, it will be possible to achieve a contrast resolution up to 1000 times higher than that achievable with standard CT equipment. The technology is potentially applicable to theragnostic applications, e.g. integrating systems for controlled drug delivery using magnetic fields.

Reference market: Incremental innovation, Impacts on existing markets

Development stage: Prototype

TRL: 4, 5

Advantages: Product/process/service/technology optimization, Cost reduction **Patented technology:** Yes

Country/ies: Italy, USA, PCT

Technology validation/demonstration: Internal validation

Market positioning: Italian, European, International

Partner required: Enterprise, Seed capital, Cooperation in national /european / international project

Key words: Super Spatial Resolution SPECT, contrast-phase CT, small animal imaging, teragnostics

Url: *https://promott.cnr.it/en/technology/12/advanced-ssr-super-spatial-resolution-spect-phasecontrast-ct-for-preclinical-imaging*

SHAPED BLADE AND METHOD FOR THE GEOMETRICAL RECONFIGURATION OF CENTERLESS GRINDING PROCESS

 # Record card: 13

Thematic areas

Additive and advanced industrial manufacturing / Machine tools

Materials / Metals & alloys

Description

The invention consists in a special regulation method of the horizontal axes of operating and rubbing wheels of a centerless grinding machine coupled with an opportune blade pro le, allowing a continuous regulation of blade rest angle (angle between tangent to blade pro le at the contact point with the work piece and the horizon, denoted by γ) and workpiece height (denoted by hw), without requiring blade substitution and/or manual regulations. The regulation of γ and hw are not independent: their relationship is defined during blade profile design. This regulation can be performed in process or in the setup phase and does not require manual blade adjustment/replacement. This results in optimal processing parameters choice, leading to improved quality and shorter time of processing as well as reduced setup time.

Type of innovation: Product / process innovation in integration with an already existing technology

Description of innovative features/Competitive advantages

The proposed invention allows to vary in a simple and continuous way the work rest angle and height (this latter in a limited range) in centerless grinding operations, without stopping the process for replacing the blade. The “in-process” variation of these parameters allows to obtain more stable machining and, therefore, an adequate roundness of the pieces in a shorter time. The invention can be easily applied to existing machines and requires low hardware costs per machine, plus one-time investment in software development.

Reference market: Incremental innovation, Impacts on existing markets

Development stage: Idea

TRL: 2, 3

Advantages: Product/process/service/technology optimization, Cost reduction

Patented technology: Yes

Country/ies: Italy

Publication of technology: Published

Market positioning: Italian, European, International

Partner required: Enterprise, Private research center

Key words: Centerless grinding, pro led blade, grinding process setup

Url: *https://promott.cnr.it/en/technology/13/shaped-blade-and-method-for-the-geometricalreconfiguration-of-centerless-grinding*

METHOS FOR MEASURING COMPLEX ACOUSTIC INTENSITY WITH THREE-DIMENSIONAL RADIATIVE AND OSCILLATORY SPECTRAL RESOLUTION

 # Record card: 14

Thematic areas

ICT & Electronics / Sensor/multi-sensor technology, instrumentation
ICT & Electronics / Optics & Acoustic
Energy and environmental sustainability / Mechanical Engineering, Hydraulics, Vibration and Acoustic Engineering
Energy and environmental sustainability / Sensory
Measurement tools and Standards

Description

The invention is about the development of a device and its methodology for measuring the active and reactive sound intensity from the impedance computation. The active intensity is calculated directly in the frequency domain multiplying the complex impedance and power spectrum of the air particle velocity. A second line of post-processing is applied to obtain the overall complex sound intensity. The overall active intensity is calculated as the sum of each frequency component of its spectrum, while the overall reactive intensity is obtained as the difference between the overall apparent intensity and the overall active intensity.

Type of innovation: Product innovation

Description of innovative features/Competitive advantages

- Minimization of the experimental error in any acoustic field
- Unambiguous and physically correct definition of the complex sound intensity based on the impedance computation
- Calculation of the spectral distribution of the radiative and oscillatory forms of acoustic energy
- Computation of the total reactive intensity

Reference market: Total innovation, Creation of new markets

Development stage: Prototype

TRL: 4

Advantages: New product/process/service/technology, Cost reduction

Patented technology: Yes

Country/ies: Italy, EPO

Technology validation/demonstration: Internal validation

Market positioning: Italian, European

Partner required: Enterprise

Key words: Complex Sound Intensity, Acoustic Impedance, Acoustic Field Monitoring & Energetic Analysis, Signal Processing, Precision Measuring Device

Url: *https://promott.cnr.it/en/technology/14/method-for-measuring-complex-acoustic-intensitywith-three-dimensional-radiative-and*

MUTATED NEUROTROPHIC PEPTIDE FOR THE TREATMENT OF NEURODEGENERATIVE AND NEURO-TRAUMATIC DISEASES

 # Record card: 15

Thematic areas

Health & Biotech / Development of new drugs

Description

We have identified the presence of the poorly characterized precursor proNGF-A in human tissues, deposited its coding nucleotide sequence (GenBank MH358394) and demonstrated its neuroprotective and neurotrophic activity in vitro and in vivo. We inserted mutations into the native molecule, identified through computational analysis, which allow proNGF-A production by eukaryotic expression systems, through a method currently validated on a laboratory scale. The human proNGF-A peptide (hproNGF-A) which forms the subject of the invention, is characterized by a molecular weight of 34 kDa, a high resistance to degradation by the extracellular proteases plasmin and MMP, by a length of 296 amino acids and a theoretical isoelectric point of about 9.5.

Type of innovation: Product innovation

Description of innovative features/Competitive advantages

The use of the peptide nerve growth factor (NGF) is indicated for the treatment of neurodegenerative diseases and for the outcomes of severe neurotrauma. However, this neutrophin suffers from some important limitations, related to the activation of the TrkA receptor, which generates a hyperalgesic effect and a potential pro-tumor activity. Furthermore, NGF is extremely vulnerable to the action of extracellular matrix proteases (MMPs). Unlike the NGF peptide, proNGF-A exerts its neuroprotective action by binding to the p75NTR receptor. This potentially limits the occurrence of side effects. Furthermore, proNGF-A is extremely more resistant than NGF, allowing a more favorable modulation of therapeutic dosages in terms of safety. The production of the peptide through eukaryotic systems also guarantees greater biocompatibility.

Reference market: Impacts on existing markets

Development stage: Idea

TRL: 2, 3

Advantages: New product/process/service/technology, Product/process/service/technology optimization

Patented technology: Yes

Country/ies:EU, USA

Publication of technology: Published

Technology validation/demonstration: Internal validation

Market positioning: Italian, European, International

Partner required: Enterprise, Public research center/university, Private research center, Seed capital, Cooperation in national /european / international project

Key words: Neurodegenerative diseases, Brain traumas, Inflammation, Neurotrophic factors, Neuro-pharmaceuticals

Url: *https://promott.cnr.it/en/technology/15/mutated-neurotrophic-peptide-for-the-treatment-ofneurodegenerative-and-neuro*

INNOVATIVE BIOSENSORS FOR HUMAN AND ENVIRONMENTAL WELFARE

 # Record card: 16

Thematic areas

ICT & Electronics / Sensor/multi-sensor technology, instrumentation
Health & Biotech / Smart Devices for Health and Wellness
Agrifood / Nutrition & health
Agrifood / Food quality & safety
Health & Biotech / Biosensors
Energy and environmental sustainability / Pollution treatment (air, soil, water)
Health & Biotech / Micro and nanotechnology related to biological sciences
Energy and environmental sustainability / Sensory
Health & Biotech / Diagnostic kits

Description

Detection devices for the presence of molecules of interest (analytes) enjoyed a renewed burst with the introduction of biological components (biosensors). Their high specificity is often used in various elds, from environmental monitoring and biomedicine to the protection and promotion of agri-food products. However, the high cost of production and the lack of compatibility with mass sampling (high-throughput) sometimes limit their use. Our proposed biosensors are innovative for their ability to quickly change conformation in the presence of analytes, leading to a strong light emission easily measured by small and cheap optical detection devices. The simplicity of the selection of the highly specific biosensor for a desired analyte, the advantage of using it without any advanced skills, and the possibility of producing with low-cost technologies, put this new approach at the frontier for countless application fields.

Type of innovation: Product innovation, Product / process innovation in integration with an already existing technology

Description of innovative features/Competitive advantages

The innovative element of these biosensors is the use of multi-domain proteins (chimeras): in the presence of the analyte in a few microliters of samples, the chimera undergoes rapid and reversible conformational changes, passing from a silent state (dark state) to a high-intensity fluorescence emission (bright state), and thus allowing for a very high signal-to-noise ratio. The device to be manufactured is low cost and consists of an integrated LED/laser light interrogation system, an assay area on paper for sample housing, and an integrated system of fluorescence collection optics, spectrally resolved, for coupling the light to a digital camera connected to a smartphone. Although chimeras can be suitably selected for every type of analyte (by in vitro molecular evolution techniques), one of the goals will be the development of biosensors for the specific detection of toxic molecules in the environment or in food production.

Reference market: Total innovation, Incremental innovation

Development stage: Idea

TRL: 1

Advantages: New product/process/service/technology, Product/process/service/technology optimization, Cost reduction

Patented technology: No

Market positioning: Italian, European, International

Partner required: Enterprise, Public research center/university, Private research center, Cooperation in national /european / international project

Key words: biosensors, high-throughput, fluorescence, biophotonics, dielectric nanostructure

Url: *https://promott.cnr.it/en/technology/16/innovative-biosensors-for-human-and-environmentalwelfare*

NANOMICROFAB – OPEN RESEARCH INFRASTRUCTURE SUPPORTING COMPANIES OPERATING IN THE ELD OF MICRO AND NANO-ELECTRONICS

 # Record card: 17

Thematic areas

ICT & Electronics / Laser technologies
ICT & Electronics / Sensor/multi-sensor technology, instrumentation
ICT & Electronics / Optics & Acoustic
ICT & Electronics / Smart cities and Communities
ICT & Electronics / Robotics and control systems
ICT & Electronics / Internet of Things
ICT & Electronics / Optoacoustic sensors, Optoelectronic devices
ICT & Electronics / Nanotechnologies related to electronics and microelectronics
Additive and advanced industrial manufacturing / Packaging
Additive and advanced industrial manufacturing / Robotics
Additive and advanced industrial manufacturing / Additive manufacturing processes and materials
Additive and advanced industrial manufacturing / Factory of the Future
Additive and advanced industrial manufacturing / Vacuum/High vacuum technologies
Materials / Semiconductors and Superconductors
Health & Biotech / Smart Devices for Health and Wellness
Health & Biotech / Medical Device
Health & Biotech / Biosensors
Health & Biotech / Micro and nanotechnology related to biological sciences
Health & Biotech / Bio-medicals
Health & Biotech / Diagnostic kits
Tourism, social sciences and cultural heritage / Technologies for preservation of cultural heritage
Aerospace and Earth Science / Aeronautical technologies and avionics
Aerospace and Earth Science / Satellite technologies
Agrifood / Food quality & safety
Automotive transport and logistics
Chemicals & Physics / Atomic and molecular spectroscopy
Chemicals & Physics / Imaging & image processing
Chemicals & Physics / Electron microscopy
Chemicals & Physics / Micro and nanotechnology related to physical, chemical and exact sciences
Energy and environmental sustainability / Safety and security
Energy and environmental sustainability / Pollution treatment (air, soil, water)
Energy and environmental sustainability / Environmental engineering/technologies
Energy and environmental sustainability / Ecology & Biodiversity
Energy and environmental sustainability / Mechanical Engineering, Hydraulics, Vibration and Acoustic Engineering
Energy and environmental sustainability / Sensory
Energy and environmental sustainability / Simulation
Energy and environmental sustainability / Wearable technologies
ICT & Electronics / Electronics and microelectronics
ICT & Electronics / Information processing, information system, workflow management ICT & Electronics / Microwaves and RF

Description

The NanoMicroFab infrastructure supports companies operating in the field of micro and nanoelectronics through the supply of materials, development of processes, design, fabrication and characterization of materials and devices. NanoMicroFab makes use of existing CNR facilities of the Institute of Microelectronics and Microsystems, the Institute of Photonics and

Nanotechnologies and the Institute for the Structure of Matter and provides:

- a complete line of development of devices based on wide band gap semiconductors.
- the entire chain for the development of applications based on inorganic and organic devices on flexible substrates.
- wide range of skills and applications in the eld of sensor.
- a set of instrumentation at the state-of-the-art for the characterization of materials and the diagnostics of the manufacturing processes of devices based on inorganic/organic semiconductors.
- characterization and design of devices.

Type of innovation: Service/know how innovation

Description of innovative features/Competitive advantages

The complementarity of the know-how of the staff of the Infrastructure together with the large set of new equipment and facilities present allows to take charge of multidisciplinary services.

Reference market: Impacts on existing markets

Development stage: Prototype

TRL: 7

Advantages: New product/process/service/technology

Patentable technology: No

Patented technology: No

Market positioning: Italian, European, International

Partner required: Enterprise, Public research center/university, Cooperation in national /european / international project

Key words: Micro and nano electronics, sensors, Internet of Things, electronic and photonic devices

Url: *https://promott.cnr.it/en/technology/17/nanomicrofab-open-research-infrastructuresupporting-companies-operating-in-the-field*

HEAVY METAL WATER PURIFICATION BY POLYMERIC CRYOGEL

 # Record card: 18

Thematic areas

Materials / Plastics, polymers

Description

The current technology allows to achieve new macroporous superadsorbent polymeric materials able to remove toxic contaminants from water and soil showing excellent sequestering properties against arsenate As (V), chromate Cr (VI) and Borate B (III) ions. The material is obtained by radical cryopolymerization of the monomer 4'-vinyl-benzyl-N-methyl-D-glucamine and / or its mixtures with hydroxyethyl-methacrylate (HEMA). The technical effect of such type of process is to provide materials with a typical high porosity morphology and therefore with high performance in terms of adsorption and complexation speed. Compared to polymeric systems already known, the proposed filtering material shows a considerably high and improved sequestering and adsorbing capacity. Moreover, with simple washing operations at controlled pH, it can dispose of the adsorbed toxic residues and to be reused, keeping the same properties for a fair number of cycles.

Type of innovation: Product innovation, Process innovation, Service/know how innovation

Description of innovative features/Competitive advantages

Considering the same material weight, the polymeric cryogels show a higher adsorption efficiency towards As (V), Cr (VI) and B(III) if compared with commercial resins currently on the market. Capture tests of arsenic and chromium performed at neutral pH, highlight the possibility of reaching concentrations much lower than similar systems reported in literature as well as present in the market, by ensuring quickly the recommended limits by WHO for domestic water. The proposed method could also solve the operational complexity and costs of the technologies currently in use by making simple recyclable filter cartridges. Thanks to their spongy nature the materials can be easily disposed by holding reduced space.

Reference market: Incremental innovation, Impacts on existing markets

Development stage: Prototype

TRL: 4, 5

Advantages: Product/process/service/technology optimization, Cost reduction

Patentable technology: Yes

Patented technology: Yes

Country/ies:Italy

Technology validation/demonstration: Internal validation

Market positioning: Italian, European, International

Partner required: Enterprise, Cooperation in national /european / international project

Key words: Polymeric cryogels, Macroporous polymeric materials, Wastewater and soil remediation, Heavy metals, N-Methyl-D-glucamine

Url: *https://promott.cnr.it/en/technology/18/heavy-metal-water-purification-by-polymeric-cryogel*

FAST AND SAFE ACCESS IN PROTECTED ENVIRONMENTS

 # Record card: 19

Thematic areas

Tourism, social sciences and cultural heritage / Archeometry
Tourism, social sciences and cultural heritage / Safety and security
Chemicals & Physics / Imaging & image processing
ICT & Electronics / Sensor/multi-sensor technology, instrumentation
ICT & Electronics / Optoacoustic sensors, Optoelectronic devices
Chemicals & Physics / Atomic and molecular spectroscopy

Description

We propose an optical technique for the fast check of the presence, on the exposed surfaces of persons and objects, of explosives and their precursors, or drugs, or in general materials which are not allowed in restricted environments: airports, courts, places of worship, etc. The technique yields bi-dimensional pictures, with exposure time of < 1 sec, reporting the target substances, and their locations and quantities. The technique already provided laboratory preliminary results, to be completed, and fully validated for sensitivity and selectivity. The device could be used stand-alone, or integrated in the microwave sensors for the detection of hidden dangerous objects.

Type of innovation: Product / process innovation in integration with an already existing technology

Description of innovative features/Competitive advantages

The present techniques, yielding physical information (eg., metal detectors for ferrous materials, or radiofrequency detectors for blunt or cutting instruments) are used on all people crossing checkpoints. On the contrary, chemical detectors are used randomly, as they require sticking substrates, to be transferred to the analyzer. These latter techniques are slow, and do not guarantee a full screening. Moreover, also the checked people are not fully inspected, but only on some points. The proposed technique allows a full chemical check on all people in transit, in a very short time. As a perspective, when raising the acquisition speed, the technique could be applied on (slowly) moving people, so dramatically reducing the checking time. This improvement would allow new applications, such as crowded sport or music events.

Reference market: Incremental innovation, Impacts on existing markets, Creation of new markets

Development stage: Feasibility

TRL: 3

Advantages: New product/process/service/technology, Product/process/service/technology optimization

Patentable technology: Yes

Patented technology: No

Publication of technology: No

Market positioning: Italian, European, International

Partner required: Enterprise, Seed capital

Key words: Security checks, optical detection, explosives, drugs

Url: *https://promott.cnr.it/en/technology/19/fast-and-safe-access-in-protected-environments*

NEK6 KINASE INHIBITORS USEFUL FOR THE TREATMENT OF SOLID TUMOURS

 # Record card: 20

Thematic areas

Health & Biotech / Bio-medicals
Health & Biotech / New therapies
Health & Biotech / Development of new drugs

Description

Therapeutic strategies targeting cell cycle in cancer have in general failed in the clinic since the drugs have lacked the therapeutic index required to achieve a robust response against cancer cells with little or no cytotoxic effect on normal cells. NEK6 kinase, which is implicated in cell cycle control, has recently emerged as an attractive target for the development of novel anticancer drugs with enhanced therapeutic index. With the support of computational chemistry simulations (structure-based virtual screening and pharmacophore modelling) we discovered and patented a few small molecules able to inhibit the activity of NEK6 kinase. Our compounds displayed selectivity, antiproliferative activity against a panel of human cancer cell lines and exhibited a synergistic effect with cisplatin and paclitaxel, thus supporting a possible use for personalized oncological therapy.

Type of innovation: Product innovation

Description of innovative features/Competitive advantages

Past agents designed to block cell cycle specifically during mitosis, such as MTAs or inhibitors against cyclin-dependent kinases, aurora kinases, and Polo-like Kinase 1, have yielded disappointing clinical results due to non-malignant cell cytotoxicity. Evidence supports the hypothesis that NEK6 inhibition selectively induce the death of neoplastic cells, while saving normal cells. Identified KEK6 inhibitors emerged as hit compounds for the development of novel anticancer agents, opening the possibility of new therapeutic strategies with improved therapeutic index in personalized oncology. This would allow advantages to the pharmaceutical industry (increased efficiency and reduced costs, product differentiation in the marketplace) and to patients and clinicians (higher probability of desired outcome, low probability of side effects). Virtual screening of commercial libraries of compounds, herein used, allows an important reduction of costs of the chemicals.

Reference market: Total innovation, Impacts on existing markets

Development stage: Feasibility

TRL: 3, 4

Advantages: New product/process/service/technology

Patented technology: Yes

Country/ies: Italy, Europe, USA

Market positioning: Italian, European, International

Partner required: Enterprise, Seed capital, Cooperation in national /european / international project

Key words: precision oncology, antitumours, kinase inhibitors, virtual screening, hit compounds

Url: *https://promott.cnr.it/en/technology/20/nek6-kinase-inhibitors-useful-for-the-treatment-of-solid-tumours*

USE OF A SPECIFIC ESSENTIAL OIL (EO) WITH CYTOTOXIC EFFECT ON HUMAN METASTATIC MELANOMA CELLS

 # Record card: 21

Thematic areas

Agrifood / Nutrition & health

Health & Biotech / Regenerative Medicine

Health & Biotech / New therapies

Description

Our treatment demonstrated the ability to kill metastatic human melanoma cells, for which there are very few effective therapeutic approaches. Use of a specific Essential Oil (EO) to inhibit the replication of human metastatic melanoma cells. This EO can be used both for direct application to the skin, and administered by mouth to reach both primary and metastatic melanomas. The use of this oil has also been shown to improve the effect of anticancer drugs such as Tamoxifen and Paclitaxel, and can therefore be tested in co-administration with drugs and / or integrated antimelanoma therapies to verify their possible synergy in the induction of tumor cytotoxicity and, consequently, the reduction of drug doses. This would therefore allow:

a. a. to reduce the doses of chemotherapy drugs;
b. to decrease the consequent adverse effects, they induce in patients and improve their quality of life;
c. to lower costs for the NHS.

Type of innovation: Product / process innovation in integration with an already existing technology

Description of innovative features/Competitive advantages

Our treatment with specific EO blocks the cell cycle of human metastatic melanoma cells because it acts on the regulation of intracellular oxidative stress (ROS), metabolically active intracellular iron homeostasis (Fe2 +), and the integrity of the mitochondrial membrane. This treatment determines an increase in ROS and Fe2 +, and a depolarization of the mitochondrial membrane, which leads to the death of 50% of the cells treated at 24 hours. If given again, after the first 24 hours, it causes 100% cell death. The same effect does not appear on healthy human cells.

Reference market: Incremental innovation, Impacts on existing markets

Development stage: Feasibility

TRL: 4

Patented technology: Yes

Technology validation/demonstration: Internal validation

Market positioning: Italian, European, International

Partner required: Public research center/university, Private research center, Seed capital, Cooperation in national /european / international project

Key words: melanoma, essential oil, adjuvant, integrated oncological therapies, oxidative stress

Url: *https://promott.cnr.it/en/technology/21/use-of-a-speci c-essential-oil-eo-with-cytotoxic-effecton-human-metastatic-melanoma*

THE EXPO SOFTWARE FOR THE CRYSTAL STRUCTURE DETERMINATION BY X-RAY POWDER DIFFRACTION

 # Record card: 22

Thematic areas

Chemicals & Physics / Inorganic substances
Chemicals & Physics / Organic substances
Health & Biotech / Development of new drugs

Description

EXPO is a software for the determination of the atomic structure of various materials (organic, metallorganic, inorganic), available in the form of microcrystalline powders, in order to derive the structure-property relationships. EXPO requires the molecular formula of the material, the experimental X-ray diffraction data and, in some cases, the expected molecular geometry. The developers of EXPO, belonging to IC-CNR of Bari, have high scientific skills and provide the experimental and methodological know-how to: crystallize the material (if not available in the crystalline form); collect X-ray diffraction data through the powder diffractometer at IC-CNR; solve the structure by EXPO; support users for properly running the software and its updates. EXPO can be used by research groups and companies interested in the structural characterization of materials, e.g. chemical and pharmaceutical companies.

Type of innovation: Product innovation, Service/know how innovation

Description of innovative features/Competitive advantages

Compared to other software for structure solution by microcrystalline powder, available on the national and international market, the competitive aspects are: ease of use, supported by a user-friendly graphical interface. This feature allows effective use of EXPO also by non-experts in crystallography; high level of automatism; ability to perform all the steps of the structure solution process; update in terms of innovative theoretical approaches and advanced computational performances; continuous support by EXPO developers.

Reference market: Impacts on existing markets

Development stage: Industrialization

TRL: 8

Advantages: New product/process/service/technology

Patentable technology: No

Patented technology: No

Publication of technology: Published

Technology validation/demonstration: External validation

Market positioning: Italian, European, International

Partner required: Enterprise, Public research center/university

Key words: atomic structure, material characterisation, microcrystalline powder, X-ray diffraction, crystallography

Url: *https://promott.cnr.it/en/technology/22/the-expo-software-for-the-crystal-structuredetermination-by-x-ray-powder-diffraction*

THE QUALX SOFTWARE FOR QUALITATIVE ANALYSIS BY MICROCRYSTALLINE POWDER X-RAY DIFFRACTION

 # Record card: 23

Thematic areas

Chemicals & Physics / Inorganic substances
Chemicals & Physics / Organic substances
Health & Biotech / Development of new drugs

Description

QUALX is a software for qualitative and semi-quantitative phase analysis of materials (organic, metallorganic, inorganic), available in the form of microcrystalline powders. It uses a database distributed together with the software. QUALX identifies the crystalline chemical phase, one or more of than one, present in a material and determines approximately the weight percentages of each phase present in a mixture. QUALX requires only the experimental X-ray diffraction data. The developers of QUALX possess high scientific skills and provide the experimental and methodological know-how, to: collect X-ray diffraction data through the powder diffractometer at IC-CNR; analyze data by using QUALX; support users for properly running the software, the database and their updates. QUALX can be used by research groups and companies interested in the characterization of materials of various interests, e.g. chemical, pharmaceutical, for cultural heritage.

Type of innovation: Product innovation, Service/know how innovation

Description of innovative features/Competitive advantages

Compared to other software for qualitative and semi-quantitative analysis by microcrystalline powders, available on the national and international market, the competitive aspects are: ease of use, supported by a user-friendly graphic interface; high level of automatism; use of a frequently updated database; update in terms of innovative theoretical approaches and advanced computational performance; continuous support by QUALX developers.

Reference market: Impacts on existing markets

Development stage: Industrialization

TRL: 8

Advantages: New product/process/service/technology

Patentable technology: No

Patented technology: No

Publication of technology: Published

Technology validation/demonstration: External validation

Market positioning: Italian, European, International

Partner required: Enterprise, Public research center/university

Key words: qualitative analysis, semi-quantitative analysis, material characterisation, microcrystalline powder, X-ray diffraction

Url: *https://promott.cnr.it/en/technology/23/the-qualx-software-for-qualitative-analysis-bymicrocrystalline-powder-x-ray*

OPTIMIZATION OF CASCADE ENZYMATIC REACTIONS THROUGH INNOVATIVE ENZYMATIC IMMOBILIZATION METHODS

 # Record card: 24

Thematic areas

Materials / Processes of production & treatment of materials - Agrifood / Agriculture - Agrifood / Nutrition & health - Health & Biotech / Development of new drugs - Health & Biotech / Care, Hygiene, Cosmetics - Energy and environmental sustainability / Pollution treatment (air, soil, water)
Health & Biotech / Micro and nanotechnology related to biological sciences - Chemicals & Physics / Agro chemicals - Chemicals & Physics / Inorganic substances - Chemicals & Physics / Organic substances - Chemicals & Physics / Special chemicals - Chemicals & Physics / Sustainable substances and green chemistry
Materials / Plastics, polymers

Description

Combinations of several enzymes in a production chain are preferred to “first generation” enzymatic processes (where the "single reaction - single enzyme" principle was followed), for the synthesis of compounds with high added value starting from simple and cheap substrates. An important requirement for obtaining control in "cascade enzymatic reactions" is the ability to deliver from one biocatalyst to the next one the various intermediates, limiting as much as possible the diffusion of the latter in the solvent. The spatial and specific organization of enzymes into artificial metabolons, through conventional immobilization methodologies, is however an open challenge. Our in vivo immobilization system, through the use of ASL^{tag}s, covalently binds two or three enzymes of interest, indirectly but with nanometric precision, allowing a modulation of the production chain activity without the need to purify the biocatalysts.

Type of innovation: Process innovation

Description of innovative features/Competitive advantages

Our system allows the expression of enzymes of interest directly on the membrane of Gram$^{(-)}$ bacteria, through their gene fusion with innovative protein-tags (ASL^{tag}), without complicated and expensive puri cation processes, considerably saving times and costs of the production chain. The ASL^{tag}, in addition to exposing the enzyme to the solvent, covalently binds a part of its substrate, following its catalytic reaction. This property therefore allows the labelling of an enzyme fused to the ASL^{tag} with a desired chemical group, if the latter is first conjugated to the substrate of the protein-tag. To date, there are three ASL^{tag}s with different substrate specificities: in the presence of linkers of different shapes and sizes conjugated to their substrates, the ASL^{tag}s bind covalently to each other, allowing a spatial arrangement with nanometric precision of enzymes on the surface of the bacterium, optimizing and/or modulating the activity of the "cascade enzymatic reactions".

Reference market: Total innovation

Development stage: Idea

TRL: 1

Advantages: New product/process/service/technology

Patentable technology: Yes

Patented technology: No

Market positioning: Italian, European, International

Partner required: Enterprise, Public research center/university, Private research center, Cooperation in national /european / international project

Key words: enzyme immobilization, protein-tag, cascade enzymatic reactions, bioreactors

Url: *https://promott.cnr.it/en/technology/24/optimization-of-cascade-enzymatic-reactions-throughinnovative-enzymatic*

BIOCRYSTAL FACILITY: A STRUCTURAL BIOLOGY HUB FOR ITALIAN RESEARCHERS AND COMPANIES

 # Record card: 25

Thematic areas

Health & Biotech / Bio-informatics
Health & Biotech / Nanomedicine
Health & Biotech / Development of new drugs

Description

The Biocrystal Facility, a large multidisciplinary laboratory established at the Institute of Molecular Biology and Pathology (IBPM) of CNR, in collaboration with the Biochemistry Department of Sapienza University aims at supporting the Italian scientists and the pharmaceutical companies in the research to find new drug and vaccine against the endemic and epidemic diseases through structure-based drug design. The main Biocrystal Facility expertises are the following: recombinant proteins construct design through bioinformatics platforms; protein quaternary structure determination by analytical ultracentrifugation; high throughput crystallization screening (HTS); users support for beam-time application at the European synchrotron radiation facilities (ELETTRA, ESRF, DIAMOND) for crystal diffraction data set measurements; structure determination using MR, MIR, SIR, MAD, SAD methods; structure determination of big macromolecular complexes (> 100 kDa) by single particle cryo- EM.

Type of innovation: Service/know how innovation

Description of innovative features/Competitive advantages

The Biocrystal Facility aims at providing know-how on crystallization and structure determination of biological macromolecules and their complexes for medical and biotechnological applications. The knowledge of the three-dimensional structure of biomolecules allows the comprehension at molecular level of the physio-pathological processes and furnishes fundamental information to be used for rational drug design. The facility was born to bridge the gap between the synchrotron radiation light sources and the Italian scientific community, in order to increase their use by life sciences researchers in the central and south Italy. Its aim is also to widen the user community of structural biology facilities by training and dissemination. Finally, the facility aims at supporting the pharmaceutical and biotech companies in the research to find new drug and vaccine against the endemic and epidemic diseases, representing an urgent challenge that needs a public-private partnership.

Reference market: Total innovation

Development stage: Industrialization

TRL: 9

Advantages: New product/process/service/technology

Patentable technology: No

Patented technology: No

Market positioning: Italian, European, International

Partner required: Enterprise, Public research center/university, Private research center

Key words: Protein structure determination, bioinformatics, structure-based drug design, X-ray crystallography, single particle cryo-electron microscopy

Url: https://promott.cnr.it/en/technology/25/biocrystal-facility-a-structural-biology-hub-for-italianresearchers-and-companies

COMPACT IMAGING POLARIMETER

 # Record card: 26

Thematic areas

Aerospace and Earth Science / Satellite technologies

Materials / Optical materials

Health & Biotech / Diagnostic, Medical imaging & advanced bioimaging

Description

The final technology will add polarimetric capability to imaging cameras in the NUV/optical, providing simultaneous measurements of the different polarization states of the light. This will be obtained by the development of an innovative coating based on nanostructured emissive materials sensitive to the polarization of the incident light. A double layer film of two organic systems will be coupled to image detectors so that the two polarization components of the incoming light are converted into two different colors.

Type of innovation: Product / process innovation in integration with an already existing technology

Description of innovative features/Competitive advantages

Imaging polarimeters are commercially available, but, other than being generally expensive, complex and/or with moving parts, often they provide measurements of the components of the polarized light sampled at different points of time and/or space, thus introducing artefacts difficult to eliminate, especially when the subjects are moving. We propose a very compact (on-chip) architecture, but with the possibility, in principle, of measuring simultaneously two orthogonal component (0° and 90°, or 45° and 135° in case of liner polarization; left or right in case of circular polarization) without splitting the incoming light in two parts (thus gaining in efficiency) and sampling the image at the same spatial coordinates. This is possible depositing the organic nanostructured film on an imaging detector intrinsically sensitive to colours. The materials can be tailored to cover a wide range of wavelengths (300-1000nm) and to be sensitive to linear or circular polarization.

Reference market: Impacts on existing markets

Development stage: Feasibility

TRL: 2

Advantages: Product/process/service/technology optimization

Patentable technology: No

Patented technology: No

Publication of technology: Published

Market positioning: Italian, European, International

Partner required: Enterprise, Public research center/university, Private research center, Seed capital, Cooperation in national /european / international project

Key words: Polarimeter, Imaging cameras, Organic coatings, uorescence, linear and circuar polarization

Url: https://promott.cnr.it/en/technology/26/compact-imaging-polarimeter

COBRA-SENS: A COVID-19 FLUORESCENCE-BASED RAPID BIOSENSOR FOR THE DIRECT DETERMINATION OF VIRAL PARTICLES

 # Record card: 27

Thematic areas

Health & Biotech / Micro and nanotechnology related to biological sciences
ICT & Electronics / Sensor/multi-sensor technology, instrumentation
Health & Biotech / Bio-medicals - Health & Biotech / Diagnostic kits
ICT & Electronics / Big Data - Health & Biotech / Smart Devices for Health and Wellness
Health & Biotech / Diagnostic, Medical imaging & advanced bioimaging
Health & Biotech / Medical Device - Health & Biotech / Biosensors

Description

The dramatic global health emergency due to the SARS-CoV-2 pandemic requires new diagnostic devices capable of identifying the presence of virus particles in patient biological samples. In this direction, the development of an innovative low-cost test, which provides the result within a few minutes, which is reproducible, and which can reveal the direct presence of even a few viral particles, would be of fundamental importance for the monitoring and containment of the pandemic. CoBRa-Sens is a point-of-care test (PoCT) based on an innovative, low-cost and ultrarapid fluorescence transfer biosensor, which identifies the direct presence of the virus with high sensitivity in a few microliters of saliva. The device to be built consists of integrated system collection optics of spectrally-resolved fluorescence, for coupling the light to a digital camera connected to a smartphone.

Type of innovation: Product innovation, Product / process innovation in integration with an already existing technology

Description of innovative features/Competitive advantages

The biological moiety of CoBRa-Sens is a multi-domain protein (PMD) containing at its ends both the viral Sp1RBD (Spike domain for the interaction with human ACE2) and idACE2 (the minimal domain of ACE2). The strong interaction between them leads to a "U" shape of the PMD with an absence of fluorescence photons (dark state), since it brings a quencher molecule closer to a fluorophore, both conjugated to PMD. The surface Spike receptors on a few free viral particles in the sample, on the other hand, interrupt the Sp1RBD-idACE2 interaction, shifting the equilibrium towards a linear "I" shape of the PMD, effectively moving the quencher away from the fluorophore and allowing the emission of photons (bright state). The CoBRa-Sens could allow a very high signal/noise ratio, placing our approach at the frontier with respect to the state of the art of research, with low-cost technology and making possible its use without the need for advanced skills.

Reference market: Incremental innovation

Development stage: Idea

TRL: 1

Advantages: Product/process/service/technology optimization, Cost reduction

Patentable technology: Yes

Patented technology: No

Publication of technology: No

Market positioning: Italian, European, International

Partner required: Enterprise, Public research center/university, Private research center, Cooperation in national /european / international project

Key words: Biosensor, uorescence, protein-protein interaction, biophotonics, dielectric nanostructure

Url: *https://promott.cnr.it/en/technology/27/cobra-sens-a-covid-19- uorescence-based-rapidbiosensor-for-the-direct-determination*

DEVICE FOR THE ASSESSMENT OF OCCUPATIONAL EXPOSURE TO ELECTROMAGNETIC FIELD IN MAGNETIC RESONANCE ENVIRONMENTS

 # Record card: 28

Thematic areas

Health & Biotech / Bio-medicals

ICT & Electronics / Electronics and microelectronics

Description

The portable device is intended to assess exposure to electromagnetic elds produced by an MRI equipment. The device (dosimeter) allows to improve the analysis and study of the problems related to the exposure of the operators, starting from the technical-scientific aspects related to the exposure, also allowing to create a manual of best practices as well as to improve the professional training of operators. The dosimeter allows to: carry out the real-time measurement of exposure to the magnetic eld, and to evaluate the induced electric eld in different parts of the body thanks to the possibility of using several probes at the same time; to store the exposure values both in aggregate and detailed form; to provide staff with some recommendations on how to move around MRI room during the daily clinical practice; to archive personal exposure data on a remote server. The dosimeter can be used in all MR environments, characterized by static magnetic eld values between 0.1T and 7T, for clinical or industrial applications.

Type of innovation: Product innovation

Description of innovative features/Competitive advantages

To date, there are only a few examples on the market of devices for occupational exposure assessment to electromagnetic elds in magnetic resonance environments. The competitive advantages of our dosimeter concern the possibility of use in environments with high magnetic field scanners (up to 7T), of simultaneously measuring the exposure in multiple areas of the body with the use of different local probes, of analyzing data with innovative software, draw up a personal exposure report and use the data for training operators thanks to the use of interactive tools associated with the device (app, etc.,...). The dosimeter could be included among the utilities provided by scanner manufacturers to their customers, in order to carry out a detailed risk assessment and contribute to epidemiological studies on the effects of electromagnetic fields.

Reference market: Total innovation

Development stage: Prototype

TRL: 7

Advantages: New product/process/service/technology

Patented technology: Yes

Country/ies: Italy

Publication of technology: Published

Technology validation/demonstration: External validation

Market positioning: Italian, European, International

Partner required: Enterprise, Public research center/university, Private research center, Seed capital, Cooperation in national /european / international project

Key words: Dosimeter, Occupational Exposure, Electromagnetic Fields, MRI, Magnetic Resonance

Url: https://promott.cnr.it/en/technology/28/device-for-the-assessment-of-occupational-exposureto-electromagnetic- eld-in

LUNG ORGANOIDS EXPERIMENTAL MODELS FOR PHARMACOLOGY AND PRECISION MEDICINE APPLICATIONS

 # Record card: 29

Thematic areas

Health & Biotech / New therapies
Health & Biotech / Smart Devices for Health and Wellness
Health & Biotech / Medical Device

Description

The aim of the research group is the creation of 3D models (microorgan/ organoids) constructed using samples obtained from patients, both biopsy samples and samples collected with noninvasive techniques (exhaled breath condensate, induced sputum, blood samples). These models would allow the identification of disease biosensors and the definition of a targeted drug therapy for each patient, customizing both the drug to be used and the most effective doses (drug toxicity and efficacy tests, precision therapies and precision medicine). This system offers innovative aspects for analytical laboratory activities, favoring integrated diagnostic applications for pharmacology / precision medicine that concern both basic and clinical medicine. In this way, we will be obtained an innovative laboratory support for the physician, improving patient management with important socio-economic consequences. In view of the above innovative aspects, the method could be highly competitive in the pharmaceutical and diagnostic industry.

Type of innovation: Service/know how innovation

Description of innovative features/Competitive advantages

The competitive advantages compared to any other competitors are linked to a proven experience in the results interpretation obtained which have given rise to scientific dissemination through publications in journals with international editorial committees.

The advantage of performing these specific laboratory tests is the ability to identify the patient's phenotype, the most effective drug and the best dose to identify an intelligent drug therapy with important economic and social consequences.

The realization of specific laboratory tests could affect industries specialized in diagnostics and pharmacology, which affect public health and individual patient care. Such activities could implement industrial resources. The advantage over any competitor is our consolidated experience in the biomedical sector with national and international expertise in studies on biological samples of patients and experimental models.

Reference market: Incremental innovation, Impacts on existing markets

Development stage: Feasibility

TRL: 2, 3

Advantages: New product/process/service/technology, Cost reduction

Patentable technology: No

Patented technology: Yes

Country/ies: Italy, Europe

Publication of technology: Published

Technology validation/demonstration: Internal validation

Market positioning: Italian, European, International

Partner required: Enterprise, Public research center/university, Private research center, Cooperation in national /european / international project

Key words: Pharmacology, cell and molecular biology, lung diseases, precision medicine

Url: https://promott.cnr.it/en/technology/29/lung-organoids-experimental-models-forpharmacology-and-precision-medicine

X-RAY MICROIMAGING LABORATORY (XMI-L@B)

 # Record card: 30

Thematic areas

Chemicals & Physics / Man made fibres

Additive and advanced industrial manufacturing / Packaging

Materials

Health & Biotech / Diagnostic, Medical imaging & advanced bioimaging

Description

X-ray imaging techniques can work in i) "full- eld mode" in which the object to study (or part of it) is completely illuminated by the X-ray beam; ii) "scanning mode" in which an X-ray beam, focused through an opportune optics, illuminates in succession contiguous areas of the sample under examination, and the transmitted wave is measured by a detector placed at a proper distance from it. One of these X-ray scanning microscopes is available at the facility (X-ray MicroImaging, XMIL@b) of the Institute of Crystallography (CNR-Bari). To reconstruct the final images, the signals are properly analyzed with proprietary software (SUNBIM), created to generate quantitative images to describe variations of the sample structural components. Until recently, these X-ray microscopes could only be used if coupled with synchrotron light sources, which are extremely difficult to access. Now, at the XMIL@b we adopted the FRE+ Superbright table-top microsource with 0.07 mm spot-size at the sample.

Type of innovation: Product / process innovation in integration with an already existing technology, Service/know how innovation

Description of innovative features/Competitive advantages

The XMI-L@b couples the microsources to X-ray scattering techniques (here SAXS and WAXS) which allow to probe matter at different length scales (from Ångström to nanometre) and to achieve structural, microstructural and morphological characterization of the specimen, in a noninvasive way and without charge build-up. In particular, small-angle X-ray scattering (SAXS) is sensitive to gradients of the refractive index and hence is suitable for morphological inspection of the specimen at the nanoscale (from a few to hundreds of nanometres), whereas wide-angle X-ray scattering (WAXS) is the interference pattern due to the secondary waves scattered by the atomic electron density distribution of the sample illuminated by the X-ray beam, carrying also specific crystallographic information (type and positions of the atoms, and their symmetry relations, unit-cell size and space group). The two datasets can be registered simultaneously, or in reflection mode (GIWAXS/GISAXS) from surfaces.

Reference market: Incremental innovation, Impacts on existing markets

Development stage: Industrialization

TRL: 7, 8

Advantages: New product/process/service/technology, Product/process/service/technology optimization

Patentable technology: No

Patented technology: No

Publication of technology: Published

Technology validation/demonstration: External validation

Market positioning: Italian, European, International

Partner required: Enterprise, Public research center/university, Private research center, Cooperation in national /european / international project

Key words: X-ray Imaging, Scanning Microscopy, Materials, Fabrics, Fibres

Url: *https://promott.cnr.it/en/technology/30/x-ray-microimaging-laboratory-xmi-lb*

DEVELOPMENT AND VALIDATION OF ELECTROCHEMICAL SENSORS FOR ADVANCED DIAGNOSTIC APPROACHES AND FOR MONITORING HUMAN CHRONIC INFLAMMATORY DISEASES

 # Record card: 31

Thematic areas

Health & Biotech / Bio-medicals

Health & Biotech / Smart Devices for Health and Wellness

Health & Biotech / Biosensors

Description

The assessment of bio-humoral markers beyond clinical evaluation would allow a more comprehensive pheno/endotyping of patients affected by chronic inflammatory diseases. Therapy personalization would require a pro le of the mediators that are relevant in the disease pathogenesis and that well correlate with prognosis. Currently, the measurement of multiple biomarkers is not included in patient evaluation because it has high costs, requires centralized laboratories, experienced personnel and bulky equipment and is time-consuming. The present proposal aims at developing and validating a panel of biosensors easy to use and that match or surpass conventional standards in regards to time, accuracy and cost to deliver point-of-care diagnostics of chronic inflammatory diseases. These biosensors will be applied to easily accessible samples (blood, urine, saliva). This will be achieved through the involvement of a multidisciplinary team including engineers, biologists, and clinicians. These innovative sensors will lead to a multidimensional evaluation of the patient paving the way toward a Precision Medicine approach.

Type of innovation: Product innovation, Product / process innovation in integration with an already existing technology

Description of innovative features/Competitive advantages

The proposed technology has several advantages compared to the traditional methods used to evaluate soluble biomarkers including:

1. simplicity of use and data analysis;
2. short assay time: results obtained in less than one hour;
3. high portability: small-sized system that can be used for point-of-care diagnostics;
4. lower interferences coming from the matrix of the biological samples compared to optical techniques.

Furthermore, the proposal will have a strong impact in different areas. First of all, it will bring innovation in the medical eld as it will develop a sensitive element capable of measuring biomarkers in biological fluids. This will set the stage for an (ever closer) future of precision medicine in chronic diseases and for future applications in telemedicine for remote (at the patient's home) assessment of the daily bio-humoral setting. The impact will be strong also in the eld of electrocatalysis and sensing improving knowledge for the detection of species at very low concentration.

Reference market: Incremental innovation, Impacts on existing markets

Development stage: Idea

TRL: 2

Advantages: New product/process/service/technology

Patented technology: No

Technology validation/demonstration: Internal validation

Market positioning: Italian, European, International

Partner required: Enterprise, Public research center/university, Private research center, Seed capital, Cooperation in national /european / international project

Key words: Electochemical sensors, Nanoparticles, Inflammation, Mediators, Biological fluids

Url: *https://promott.cnr.it/en/technology/31/development-and-validation-of-electrochemicalsensors-for-advanced-diagnostic*

PROTECTIVE MASK AND KIT

 # Record card: 32

Thematic areas

Health & Biotech / Medical Device

Description

The full-face mask adapts to the face of the user; it is used in the medical eld where there may be close contact between a patient and a doctor and in all those areas of possible social overcrowding that, in case of a pandemic, may lead to the spread of a virus. To date, as the main means of containment and prevention of infection, are used masks made of fabric or equipped with filter that adhere to the face of the user in order to shield nose and mouth and / or filter the air inhaled and / or exhaled by the user. These masks are uncomfortable to wear and have several disadvantages. The patented mask has an upper part that includes a transparent visor whose purpose is to protect the eyes of the wearer and a lower part that includes a filtering portion that allows the user to breathe. The mask is comfortably wearable, allows to keep the mouth and nose free from constrictions or discomfort, allows to completely isolate the face avoiding contact with hands and everything that surrounds the user.

Type of innovation: Product innovation

Description of innovative features/Competitive advantages

The mask is adaptable to the user's face; it allows to completely isolate the face avoiding also the contact with the user's hands and therefore all that surrounds him reducing the diffusion of viruses; the nose and the mouth are free of constrictions; it is easily wearable by anyone; it can be made of biocompatible material; the main components (visor and filtering portion) can be easily removed and replaced; it allows a reduction of humidity formation when the user is talking or in case he is doing physical activity.

Reference market: Incremental innovation, Impacts on existing markets

Development stage: Prototype

TRL: 5

Advantages: Product/process/service/technology optimization

Patented technology: Yes

Country/ies: Italy

Market positioning: Italian

Partner required: Enterprise

Key words: Virus mask, full-face respirator

Url: *https://promott.cnr.it/en/technology/32/protective-mask-and-kit*

NANOTECHNOLOGIES AS INNOVATIVE THERAPEUTIC APPROACHES FOR THE TREATMENT OF CHRONIC RESPIRATORY DISEASES

 # Record card: 33

Thematic areas

Health & Biotech / Bio-medicals
Health & Biotech / New therapies
Health & Biotech / Nanomedicine
Health & Biotech / Development of new drugs

Description

Severe asthma or chronic obstructive pulmonary disease (COPD) are nowadays associated with a poor response to corticosteroids which led to the use of high-dose with consequent improved onset of side effects. The use of nanotechnologies can represent an innovative approach for the effective treatment of both asthma and COPD. The development of new nano-formulations.
involving the use of nanomaterials and specifically tailored to be inhaled offers numerous advantages over conventional inhaled dosage forms. Bronchial epithelial cells are one of the primary targets of inhaled drugs and offer an ideal model for evaluating the biocompatibility and effectiveness of new nano-systems delivered via pulmonary or nasal rout by inhalation, even in conditions of high oxidative stress typical of the most severe diseases. The analysis of cellular signals involved in normal and/or pathological conditions, such as oxidative stress, inflammation and cellular degeneration, may be predictive of the pharmacological effects of the new formulations along with their potential as innovative therapies/treatments.

Type of innovation: Product innovation

Description of innovative features/Competitive advantages

The development of new nanocarriers, for the delivery of a wide variety of natural and synthetic drugs is performed by the Laboratory of Biocompatible Polymers of the Univ. of Palermo and by the Pharmaceutical Sciences Section of the Univ. of Cagliari by the use of news polymers and systems. The new drug delivery systems have several advantages: the use of low doses of drug leading an effective therapeutic effect; reduction of drug resistance; increased bioavailability; controlled release of the incorporated drug; increased deposition and pulmonary retention; reduction of side effects. The use of specific in vitro model of respiratory epithelium, is performed by the IRIB of Palermo and it has the advantage to reproduce in vitro special conditions such as high oxidative stress or inflammation typical of the most severe forms of both asthma or COPD. Such models allow to evaluate the application of new nanosystems even under severe conditions that cannot be effectively treated by using traditional therapies.

Reference market: Incremental innovation

Development stage: Idea

TRL: 1

Advantages: New product/process/service/technology

Patentable technology: Yes

Patented technology: No

Publication of technology: No

Technology validation/demonstration: Internal validation

Market positioning: Italian, European, International

Partner required: Enterprise, Public research center/university, Private research center, Cooperation in national /european / international project

Key words: Nanotechnologies, Asthma, COPD, Airway epithelium, Nanocarriers

Url: *https://promott.cnr.it/en/technology/33/nanotechnologies-as-innovative-therapeuticapproaches-for-the-treatment-of-chronic*

COVERING DEVICE FOR POTS

 # Record card: 34

Thematic areas

Agrifood / Agriculture

Description

The containers for plants and the like have different shapes, an open top to facilitate irrigation and material supply; a base that includes one or more holes to facilitate proper water drainage and to ensure ventilation for the rooting apparatus. An inconvenience of these containers is related to their placement in outdoor environments without roofs: in the presence of "unfavorable" climatic conditions, excessive exposure to rainwater rather than excessive exposure to the sun, these containers expose plants to a series of problems. The covering device for pots is available in different sizes and shapes and is composed of two elements: half-cover one and half-cover two with a stiffness and a thickness such as to support the weight of rain and a slope such as to facilitate the ow of water downwards. The two elements are locked around the stem of the plant and have on the top two ns that slide on each other, on guide channels, for the opening/closing of the device.

Type of innovation: Product innovation, Product / process innovation in integration with an already existing technology

Description of innovative features/Competitive advantages

The device is easily adaptable to pots on the market without the need to disrupt existing production lines; the application or removal is not invasive for plants because it adapts to their stems; it allows plants to maintain the right hydration of the soil in case of excessive exposure to the sun; avoids the leakage of soil in case there is excessive exposure to adverse weather phenomena such as rain or wind, with the consequent loss of nutrients essential for growth; avoids the excessive introduction of water in case of heavy rains and the consequent stagnation that could rot both the stem and the leaves.

Reference market: Incremental innovation, Impacts on existing markets

Development stage: Prototype

TRL: 7

Advantages: New product/process/service/technology

Patented technology: Yes

Country/ies: Italy

Technology validation/demonstration: External validation

Market positioning: Italian

Partner required: Enterprise

Key words: Pots, Cover, Thermal control, Protection plant

Url: *https://promott.cnr.it/en/technology/34/covering-device-for-pots*

NEUROPROTECTIVE COMPOUNDS

 # Record card: 35

Thematic areas

Agrifood / Nutrition & health

Health & Biotech / Development of new drugs

Health & Biotech / Care, Hygiene, Cosmetics

Description

We have identified compounds that show a neuroprotective action *in vivo*, in models of neurodegenerative diseases (e.g. SMA, Parkinson, Alzheimer, Huntington) in the model organism *C. elegans*. These compounds consist of: mixtures of 22 natural extracts, 15 natural molecules and 11 synthetic molecules. As for the natural extracts, for many of them we have identified the types of plants, cultivars, parts of the plant, methods of chemical extraction, physical treatments and growing conditions, which give the best neuroprotective abilities in different disease models. The dose response was evaluated for natural and synthetic molecules. It was also possible to identify the molecular mechanism of action for some of the compounds under examination. The best hits are being validated using mammalian cell cultures.

Type of innovation: Product innovation

Description of innovative features/Competitive advantages

The technology is characterized by a cross-cutting interest for the nutraceutical and pharmaceutical industries, either for the production of functional foods with neuroprotection and prevention capabilities for neurodegenerative diseases, or for the production of drugs. Many neurodegenerative diseases of genetic origin, being rare, are less studied, and for this reason defined as “orphans”. Furthermore, the increase of the life span in Western countries is associated with an increase in neurodegenerative diseases related to age. For these reasons, the identification of new neuroprotective molecules is of great interest to the market. Many of the compounds were obtained from edible plants and therefore non-toxic to humans, and some of them are from parts normally discarded (sustainable sources). Furthermore, the model system used (*C.elegans*) allows, compared to other model animals, to perform further characterization analysis in a very short time (days), at low cost and without the sacrifice of vertebrate animals.

Reference market: Incremental innovation, Impacts on existing markets

Development stage: Feasibility

TRL: 2, 3

Advantages: New product/process/service/technology, Product/process/service/technology optimization, Cost reduction

Patentable technology: Yes

Patented technology: No

Publication of technology: No

Technology validation/demonstration: Internal validation

Market positioning: Italian, European, International

Partner required: Enterprise, Private research center, Seed capital, Cooperation in national /european / international project

Key words: Neurodegeneration, Model systems, Rare genetic diseases, Prevention, Sustainable sources

Url: *https://promott.cnr.it/en/technology/35/neuroprotective-compounds*

HIGH THROUGHPUT PLATFORM FOR IN VIVO SCREENINGS

 # Record card: 36

Thematic areas

Agrifood / Agriculture
Agrifood / Nutrition & health
Agrifood / Food quality & safety

Description

We developed a procedure aimed at simultaneously treating thousands of *C.elegans* model organisms, from eggs to old adult, in liquid, in 96- or 384-well plates. This procedure can be used to perform drug and toxicological screening of millions of compounds, in very small volumes and on millions of animals. Thanks to easy handling, semi-automatic analysis can be performed using plate readers or High Content Screening instruments. It is therefore possible to use several different starting conditions in each well in terms of genotype, number of animals, volumes, nutrients and treatments. This can be further enhanced by dispensing with automated liquid handling devices. Nematocides, food contaminants, drugs and toxic substances can be identified with this system.

Type of innovation: Service/know how innovation

Description of innovative features/Competitive advantages

In recent years, the use of small model organisms, such as *C.elegans*, has proved extraordinarily productive for toxicology and pharmacology studies. These animals are easily manipulated experimentally, microscopic but multicellular and with different tissues and organs, which allows the analysis of millions of compounds of interest. In addition, models of many diseases have already been set up that allow to detect the effect of compounds on particular conditions. The biology of *C. elegans* is extremely well known and therefore offers the knowledge to accurately interpret the screening results. *C. elegans* is economically very advantageous compared to other models and offer quick answers (3-21 days). It makes it possible to reduce the sacrifice of vertebrate animals whose use, when not strictly necessary, finds widespread opposition in society.

Reference market: Total innovation, Impacts on existing markets

Development stage: Industrialization

TRL: 8, 9

Advantages: New product/process/service/technology

Patented technology: No

Technology validation/demonstration: External validation

Market positioning: Italian, European, International

Partner required: Enterprise, Public research center/university, Private research center, Cooperation in national /european / international project

Key words: Nematocides, Toxicology, REACH, Food contaminants, drugs

Url: *https://promott.cnr.it/en/technology/36/high-throughput-platform-for-in-vivo-screenings*

PIEZOELECTRIC TUNING-FORK SENSOR FOR SCANNING PROBE MICROSCOPY WITH HIGH SENSITIVITY

 # Record card: 37

Thematic areas

Chemicals & Physics / Micro and nanotechnology related to physical, chemical and exact sciences
Measurement tools and Standards

Description

Quartz tuning forks are employed in scanning atomic force microscopy (AFM), as well as in some derived techniques, as high sensitivity detectors of interactions, of both conservative and dissipative kind, between the AFM nanometric probe and the investigated surface. However, the contributions of the two kinds of interaction result as convoluted in the sensor response, preventing fully quantitative measurements of the quantities of interest. The state-of-the-art solution resorts to modified quartz sensors in order to be independently sensitive to both the interaction kinds, although giving up most of their sensitivity. The proposed technology modifies tuning fork sensors, in both their structure and driving modality, in order to maintain their characteristic high sensitivity, but at the same time, the separation of the effects of the two kinds of interaction.

Type of innovation: Product / process innovation in integration with an already existing technology

Description of innovative features/Competitive advantages

Employment of the proposed sensor could lead to improved performance of scanning probe microscopy systems like AFM and related techniques, by combining the typical high sensitivity of tuning fork sensors to better discrimination of the two components of the force signal. This would be obtained at the expense of some complication of the driving modality of the sensor, through additional electronics.

Reference market: Impacts on existing markets

Development stage: Prototype

TRL: 3, 4

Advantages: Product/process/service/technology optimization

Patentable technology: Yes

Patented technology: No

Publication of technology: Published

Technology validation/demonstration: Internal validation

Market positioning: Italian, European, International

Partner required: Enterprise, Cooperation in national /european / international project

Key words: Microscopy, Tuning fork, Sensor, AFM, Surface

Url: *https://promott.cnr.it/en/technology/37/piezoelectric-tuning-fork-sensor-for-scanning-probemicroscopy-with-high-sensitivity*

QUASI-PERIODIC LOCKED LOOP (Q-PLL)

 # Record card: 38

Thematic areas

Materials / Properties of materials, corrosion, degradation
ICT & Electronics / Sensor/multi-sensor technology, instrumentation
ICT & Electronics / Optics & Acoustic
ICT & Electronics / Robotics and control systems
Health & Biotech / Medical Device
Health & Biotech / Micro and nanotechnology related to biological sciences
Health & Biotech / Bio-medicals
ICT & Electronics / Electronics and microelectronics
ICT & Electronics / Information processing, information system, workflow management
ICT & Electronics / IT and Telematics applications
ICT & Electronics / Multimedia
ICT & Electronics / Telecommunications

Description

The Q-PLL is a nonlinear circuit which can maintain a locked state when forced by two incommensurate frequencies.
The locked state is a third frequency parametrically selected among those prescribed by the theory of three-frequency resonances in dynamical systems.
In particular, the locked frequency forms a three-frequency resonance with the frequencies of the quasi- periodic input and is closely related to the pitch perception of complex sound in humans.
The circuit is able to lock also in case of deterministic perturbation (harmonics of the input frequencies) and stochastic perturbation (wide-band noise). It is also an extension of the Phase Locked Loop (PLL) with the additional ability of locking simultaneously to more than one frequency.

Type of innovation: Product / process innovation in integration with an already existing technology

Description of innovative features/Competitive advantages

Due to the robustness of the locked states, the Q-PLL represents a basis for the development of applications, for example, in medicine (hearing aids, and cochlear implants), in robotics (artificial senses), and in industrial and consumer electronics (improvement of speech intelligibility, pitchbased processing, etc.). As an extension of the PLL, through further development and, it could find unexpected applications, which includes but also goes beyond those of the PLL and could generate a new family of nonlinear circuits for widespread application.

Reference market: Incremental innovation, Impacts on existing markets
Development stage: Prototype
TRL: 4
Advantages: New product/process/service/technology
Patented technology: Yes
Country/ies: Italy, PCT
Technology validation/demonstration: External validation
Market positioning: Italian, European, International
Partner required: Enterprise, Private research center
Key words: Frequency locking, Quasi-periodic signals, Pitch perception, Non-linear electronics
Url: *https://promott.cnr.it/en/technology/38/quasi-periodic-locked-loop-q-pll*

TECHNOLOGY FOR THE SPACE-TIME MEASUREMENT OF SEA WAVES FROM MOVING PLATFORMS

 # Record card: 39

Thematic areas

Aerospace and Earth Science / Oceanography

Energy and environmental sustainability / Renewable sources

Description

The invention concerns an apparatus for measuring the three-dimensional (3-D) sea surface elevation from moving and floating platforms. In particular, the invention consists of two or more synchronized digital video-cameras that frame, from distinct and remote points of view, a common portion of the sea surface. A triangulation process makes it possible to obtain a three-dimensional reconstruction of the sea surface from these images. The invention is particularly suitable for measuring sea waves. The apparatus is equipped with IT procedures for the automatic calculation of the mutual position of the cameras and the roto-translation between the cameras and the mean sea level. The stereo cameras are also interfaced with an instrument (Inertial Motion Unit, IMU, and Global Positioning System, GPS) for the measurement over time of the 6 degrees of freedom (3 rotations and 3 translations) which completely de ne the instantaneous rigid motion of the vessel (subject to waves and therefore moving in the 3-D space). The invention is accompanied by 3-D data analysis techniques that improve the accuracy of movement correction. The invention is particularly suitable for the collection of scientific data in different sea states from research or ships of opportunity, as well as being used by vessels for "operational" knowledge of the sea state. The latter data can increase the safety of navigation and operations on board.

Type of innovation: Product innovation, Service/know how innovation

Description of innovative features/Competitive advantages

The instrument allows the accurate measurement of the sea states (surface waves) by using stereo cameras achievable at a low cost. It is particularly designed for the wave characterization from moving ships or any other floating structure, whose operativity depends on the sea state characteristics (e.g., wind turbines). Its features make the instrument also easily deployable in locations where the human access is difficult (e.g. lighthouses).

Reference market: Total innovation, Impacts on existing markets, Creation of new markets

Development stage: Prototype

TRL: 7

Advantages: New product/process/service/technology, Cost reduction

Patented technology: Yes

Country/ies: Italy

Technology validation/demonstration: Internal validation

Market positioning: Italian, European, International

Partner required: Enterprise, Public research center/university, Private research center, Cooperation in national /european / international project

Key words: Ocean waves, Stereo cameras, Misura inerziale del movimento, Navigazione, Interial Motion Unit, Ships

Url: *https://promott.cnr.it/en/technology/39/technology-for-the-space-time-measurement-of-seawaves-from-moving-platforms*

RAMAN SPECTROSCOPY FOR ONCOLOGICAL DIAGNOSIS

 # Record card: 40

Thematic areas

Health & Biotech / Micro and nanotechnology related to biological sciences
Health & Biotech / Nanomedicine
Health & Biotech / Diagnostic, Medical imaging & advanced bioimaging
Chemicals & Physics / Micro and nanotechnology related to physical, chemical and exact sciences
ICT & Electronics / Artificial Intelligence

Description

Recently, it has been demonstrated that Raman spectroscopy can play a fundamental role in assisting the work of the anatomopathologist by allowing classification of oncological samples with practically 100% accuracy in oncological diagnosis. Raman spectroscopy consists in illuminating the tissues under analysis with a laser and collecting the radiation diffused by the molecular vibrations from the samples. This gives the possibility to have a molecular fingerprint of the tissues under analysis and, so, allowing to identify specific biomolecules in healthy or sick tissues. In turn, the degree of malignancy of oncological samples can be carefully characterized. Based on the current state of the art of Raman spectroscopy technology level, our technological proposal concerns: 1) the development of a software based on Artificial Intelligence algorithms to be applied to data processing to classify the tissues under analysis; 2) improvement and customization of instrumentation for anatomopathology laboratories; 3) relatively to melanoma cancer, the development of customized instrumentation for the screening of nevi in large sections of the population.

Type of innovation: Product innovation, Process innovation, Service/know how innovation

Description of innovative features/Competitive advantages

The proposed innovation can be subdivided into three points listed in order of impact: 1) the development of a software based on AI techniques for data processing of datasets generated during the application of Raman spectroscopy to oncological samples. The software allows to classify and diagnose the oncological tissues under analysis giving the possibility to perform diagnoses with 100% accuracy. This software can be applied to the diagnosis of any type of tumor. When applied to melanoma, Raman spectroscopy instrumentation can be customized to perform fast and reliable screening of the population, and this ability stimulates the second impact of the proposed innovation: 2) customization of the instrumentation related to Raman spectroscopy for screening of nevi of large population in outdoor conditions (pharmacies, etc.). The third point, 3) is the customization of the Raman spectroscopy instrumentation to be used in the histology and anatomopathology laboratories with dedicated technical staff. Steps 2 and 3 use the software developed in step 1.

Reference market: Incremental innovation, Impacts on existing markets

Development stage: Feasibility

TRL: 3, 4

Advantages: New product/process/service/technology, Cost reduction

Patentable technology: Yes

Patented technology: No

Market positioning: Italian, European, International

Partner required: Enterprise, Private research center, Seed capital, Cooperation in national /european / international project

Key words: Raman spectroscopy, Oncological diagnosis, Multivariate statistics, melanoma, Histology and anatomopathology

Url: *https://promott.cnr.it/en/technology/40/raman-spectroscopy-for-oncological-diagnosis*

TITANIUM SURFACES MODIFIED WITH NANO-TOPOGRAPHY AND NANOTEXTURED KERATIN COATING FOR DENTAL IMPLANT COLLARS

 # Record card: 41

Thematic areas

Health & Biotech / Micro and nanotechnology related to biological sciences
Health & Biotech / Medical Device
Materials / Processes of production & treatment of materials
Chemicals & Physics / Micro and nanotechnology related to physical, chemical and exact sciences

Description

The technology is intended to face the main problems of transmucosal dental implants, such as peri-implant mucositis, peri-implantitis and epithelial downgrowth. The strategy foresees the development of a surface able to favor soft tissues growth (gum sealing), limit at the implant collar these tissues, reduce bacterial adhesion and eventually have an antibacterial action. To reach these goals a titanium surface can at first be modified from a topographical standpoint with the obtainment of oriented grooves for soft tissues guidance, the surface can be covered with keratin nano fibers in a second step to enhance soft tissues growth (oriented with oriented fibers).
Both these steps do not increase bacterial adhesion compared to a smooth titanium surface.
Finally, an antibacterial action can be added by keratin doping with antibacterial ions (e.g. Ag).

Type of innovation: Product innovation

Description of innovative features / Competitive advantages

The market of transmucosal dental implants actually does not offer solutions similar to the one proposed. The here proposed technology presents a surface specifically designed in order to limit bacterial adhesion, guide and stimulate the growth of soft tissues and offer the possibility to have an effective antibacterial action (metal ion doping). The proposed solution allows the stimulation of soft tissues and their confinement to the implant collar region. The technology is multi-step with different complexity levels and allows the development of several commercial solutions for specific needs. Finally, the technology is environmentally friendly since it does not employ toxic reagents but uses keratin from industrial byproducts sustaining circular economy and local development.

Reference market: Incremental innovation, Impacts on existing markets

Development stage: Feasibility

TRL: 2

Advantages: New product/process/service/technology

Patented technology: Yes

Country/ies: Italy

Market positioning: Italian, European, International

Partner required: Cooperation in national /european / international project

Key words: Dental implant collar, Titanium, Keratin, Soft tissues, Antibacterial

Url: *https://promott.cnr.it/en/technology/41/titanium-surfaces-modi ed-with-nano-topographyand-nanotextured-keratin-coating-for*

DETECTOR FOR INTRACAVITARY IMAGING

 # Record card: 42

Thematic areas

Health & Biotech / Bio-medicals
Health & Biotech / Medical imaging & equipment
Health & Biotech / Diagnostic, Medical imaging & advanced bioimaging
Health & Biotech / Medical Device

Description

The present invention relates to a gamma camera for intracavitary use, which is widely used in the eld of radio-guided surgery (intra-operative and laparoscopic and robotic-assisted) for the localisation of lymph nodes and tumours and/or other pathologies. The aim of the present invention is to make available an intraoperative tool able to overcome the drawbacks of the present known art. A further scope of the present invention is to develop a low cost intracavitary gamma camera with high versatility, providing an on-line imaging of the radio pharmaceuticals uptake in the tissues or more generally in the lesion.

Type of innovation: Product innovation, Product / process innovation in integration with an already existing technology

Description of innovative features / Competitive advantages

The detector can be introduced into the human body through dedicated channels (trocar or other) which guide the use of the device. The main advantage is to bring the detector into contact with the suspected pathology inside the body rather than checking it from the outside. The ability to explore small eld areas inside the body allows to obtain very detailed images with high spatial resolution (1-2 mm) and paves the way to the use of dedicated devices in precision robotic surgery.

Reference market: Total innovation, Impacts on existing markets

Development stage: Feasibility

TRL: 2, 3

Advantages: New product/process/service/technology

Patentable technology: Yes

Patented technology: Yes

Country/ies: Italy, PCT

Publication of technology: No

Technology validation/demonstration: Internal validation

Market positioning: Italian, European, International

Partner required: Enterprise, Seed capital, Cooperation in national /european / international project

Key words: Intraoperative scintigraphic imaging, Mini gamma camera, Surgical scintigraphic device

Url: *https://promott.cnr.it/en/technology/42/detector-for-intracavitary-imaging*

A LARGE-SIGNAL NON-QUASI-STATIC COMPACT MODEL FOR PRINTABLE ORGANIC ELECTRONICS

 # Record card: 44

Thematic areas

ICT & Electronics / Electronics and microelectronics - ICT & Electronics / Internet of Things

Description

The technology for organic thin film transistors (OTFTs) is suitable for large area electronics, disposable electronics and "Internet of Things" applications. Circuits employing OTFTs can be realized by using very cheap printing technologies. The electrical behavior of these devices is essentially different from the behavior of silicon MOSFETs and, in order to enable circuit design, compact models specific for OTFTs are needed.

The presented technology is an electrical compact model for OTFTs that:

a) rely on microscopic charge and mobility models specifically tailored for organic semiconductors;
b) reproduce the large-signal regime and non-quasi-static effects that are very likely to occur inorganic TFTs;
c) account for the presence of parasitic regions, outside the channel area, that are very likely to be present in devices obtained by printing processes with large alignment tolerances.

The model can be used as an “add-on” in most of the software packages for circuit simulation (SmartSpice, Spectre, ELDO, ...)

All these features make this model particularly well suited for the simulation of OTFTs realized by printing process.

Type of innovation: Product innovation

Description of innovative features / Competitive advantages

Nowadays, investigations of the electrical behavior of OTFTs have mainly focused on modeling of the DC regime, while reproduction of AC operation has received less attention with most of the efforts devoted to the modeling of the quasi-static regime. However, it is well established that the order of magnitude of the cut off frequencies of OTFTs is in the range of few kilohertz and it is very likely that, in real applications, organic circuits must operate at frequencies driving the devices in a non quasi static (NQS) regime.

Being specifically designed for NQS regime, the proposed model provides a more accurate design in dynamic operation.

Benefits:

- The compact model is able to reproduce the static as well as the dynamic behavior of OTFTs.
- It is implemented in the Verilog-A programming language, so it can be used in most of the commercial electronic design automation (EDA) tools.
- The accuracy of the computation can be increased (at the expense of computation speed).
- The compact model is easily adaptable to complex printing layouts, that could include parasitic (floating) regions not bounded by electrodes.

Reference market: Incremental innovation, Impacts on existing markets

Development stage: Prototype

TRL: 4

Advantages: New product/process/service/technology

Patentable technology: No

Patented technology: No

Technology validation/demonstration: Internal validation

Market positioning: Italian, European, International

Partner required: Enterprise, Private research center, Cooperation in national /european / international project

Key words: Organic electronics, Compact model, Large Signal Dynamical Simulation, High Frequency

Url: *https://promott.cnr.it/en/technology/44/a-large-signal-non-quasi-static-compact-model-forprintable-organic-electronics*

COMPOSITE GEOPOLYMERS FOR THERMO-STRUCTURAL APPLICATIONS

 # Record card: 45

Thematic areas

Materials / Building materials
Materials / Ceramic materials
Materials / Composite and hybrid materials
Automotive transport and logistics / Vehicles
Automotive transport and logistics / Shipbuilding
Automotive transport and logistics / Propulsion
Aerospace and Earth Science / Aeronautical technologies and avionics

Description

CNR-ISTEC develops geopolymer composites for thermostructural applications, such as: self-supporting cavities; thermal and acoustic insulation; thermal and re barriers; high temperature coatings and damping; molds and cores for foundry; foams and refractory linings. Geopolymers are chemically bonded materials at T <300 ° C. Being inorganic polymers without water in the structure, they tolerate high temperatures: they are incombustible, do not emit gas or fumes and do not explode. The three classes of thermostructural geopolymer composites currently developed are the following: composites with dispersion of particles (refractory fillers, light aggregates) and / or short fibers (synthetic or natural, etc.), including waste; porous composites to increase lightness and insulating power; composite materials that involve the impregnation of long fibers and fabrics or the drowning of an internal reinforcement similar to composite materials with organic resins.

Type of innovation: Product innovation, Process innovation, Service/know how innovation

Description of innovative features / Competitive advantages

This technology allows the near-net-shape production of materials with ceramic properties in the same way as some plastics. CNR-ISTEC formulates ad hoc functionalized inorganic resins that adapt to hand lay-up and vacuum bagging or vacuum in filtration processes used for fiber reinforced organic polymers. The proposed technology is mature and the criticalities encountered for a possible transfer to the market can be overcome thanks to the coupling with commercial materials (multimaterials) and already existing technologies. The processability and high temperature resistance (600-800 ° C) guarantee a strategic application, for example in the transport sector, where the solutions marketed to date are particularly expensive, not in line with the development objectives inherent to decarbonisation (EU objectives to 2030) and with application limits to production niches.

Reference market: Incremental innovation, Impacts on existing markets

Development stage: Prototype

TRL: 4, 5, 6

Advantages: New product/process/service/technology, Product/process/service/technology optimization, Cost reduction Patentable technology: Yes

Patented technology: Yes

Country/ies: Italy

Technology validation/demonstration: Internal validation

Market positioning: Italian, European, International

Partner required: Enterprise, Cooperation in national /european / international project

Key words: Geopolymers, Inorganic polymers, Thermo-structural applications, Composite, Fiberreinforced

Url: *https://promott.cnr.it/en/technology/45/composite-geopolymers-for-thermo-structuralapplications*

VALORIZATION OF INDUSTRIAL WASTE THROUGH GEOPOLYMERIZATION PROCESSES

 # Record card: 46

Thematic areas

Materials / Processes of production & treatment of materials
Materials / Building materials
Chemicals & Physics / Inorganic substances
Energy and environmental sustainability / Building materials
Materials / Ceramic materials
Automotive transport and logistics / Vehicles
Automotive transport and logistics / Shipbuilding
Chemicals & Physics / Sustainable substances and green chemistry
Aerospace and Earth Science / Aeronautical technologies and avionics
Energy and environmental sustainability / Waste management

Description

Geopolymers belong to the class of chemically bonded ceramics: they are synthesized at low temperatures and are eco-friendly, as besides the low consolidation temperature required by the process they can be produced from secondary raw materials and industrial waste of various kinds, thus reducing the energy demand and the environmental impact of the entire production cycle. Materials such as y ash, steel mill slag, biomass ash, sludge and silt, extractive residues, mineral and ceramic powders, organic or inorganic waste fibers, plastics, etc. can be used as precursors or as functionalizing fillers, depending on their reactive, partially reactive or inert nature. Based on the final application required, CNR-ISTEC recycles and valorizes industrial waste and by-products of various kinds, designing new materials with high added value and low environmental impact.

Type of innovation: Product innovation, Process innovation

Description of innovative features/Competitive advantages

Geopolymers allow the use and processing of materials with ceramic properties in the same way as some plastics, avoiding the use of heavy equipment and high temperatures typical of industrial ceramic plants. Such technology also allows the reconversion of industrial waste into secondary raw materials for the production of components and systems with high added value, promoting a reduction in the environmental and economic impact associated with the disposal of such waste. It is an extremely versatile technology, which can be exploited in various industrial sectors, such as civil and infrastructural engineering, construction, eco-design, street furniture, plastic and composite industries, non-ferrous metal foundries and metallurgy, art and decoration, biomaterials, etc.

Reference market: Incremental innovation, Impacts on existing markets

Development stage: Prototype

TRL: 4, 5

Advantages: New product/process/service/technology, Cost reduction

Patented technology: Yes

Country/ies: Italy

Publication of technology: Published

Technology validation/demonstration: Internal validation

Market positioning: Italian, European, International

Partner required: Enterprise, Cooperation in national /european / international project

Key words: Geopolymers, Waste, Circular economy, Green chemistry, Recycle

Url: *https://promott.cnr.it/en/technology/46/valorization-of-industrial-waste-throughgeopolymerization-processes*

ROBOTIZED INCLINOMETRIC SYSTEM

 # Record card: 47

Thematic areas

Energy and environmental sustainability / Environmental engineering/technologies
Aerospace and Earth Science / Geological engineering
Energy and environmental sustainability / Sensory
Measurement tools and Standards
ICT & Electronics / Robotics and control systems
Energy and environmental sustainability / Natural disasters

Description

AIS aim is a robotized inclinometer measurement in standard inclinometer boreholes. The deep measurements have multiple applications, including evaluating the rate of deep-seated ground deformation in landslide areas, evaluating the volume of deep-seated landslides and assessing landslide hazards. The AIS is composed by an electronic control manager, an inclinometer probe and an electric motor equipped with a high precision encoder for handling and continuous control of the probe in the borehole. The probe is automatically lowered into the borehole and traced to make measurements at predetermined elevations. The measurements are stored directly in the probe. During the cycle measurements the probe is independent without communications with the surface control unit. At the end of the measuring phase, data are transmitted via wireless to a surface central unit. This one processes data and transmits the results to a remote servers for near-real time monitoring and further analysis. Thanks to the electronic control AIS is able to perform measurements with a high repeatability and with a revisit time that cannot be matched by a human operator.

Type of innovation: Product / process innovation in integration with an already existing technology

Description of innovative features/Competitive advantages

AIS is able to perform measurements with a double reading approach (0 °/ 180°) providing very high quality data. The development of a battery-powered electronic microsystem (directly connected to the probe), made it possible to eliminate the signal transmitting cable linked to the surface processing system. The AIS uses only a small synthetic fiber cable (Dyneema®, Ø 2 mm) to support the probe and a low consumption micro-motor for its descent and ascent into the borehole. Thanks to its low consumption, the AIS can be powered by solar panels. AIS has a high measurement frequency (up to 6 ÷ 8 meas / day) with high discretization of the vertical (reading step of 50 cm); it is also possible to choose the starting measurement position. AIS is compatible with standard inclinometer tubes (from 1 to 120 meters) and it can be installed in a short time, removable and reusable. Its small size allows it to be stored in a standard fiberglass cabinet.

Reference market: Incremental innovation, Impacts on existing markets

Development stage: Prototype

TRL: 5

Advantages: New product/process/service/technology, Cost reduction

Patented technology: Yes

Country/ies: Italy

Publication of technology: Published

Technology validation/demonstration: External validation

Market positioning: Italian

Partner required: Enterprise

Key words: Inclinometer, Landslides, Monitoring systems, Subsoil observation, Geo-engineering

Url: *https://promott.cnr.it/en/technology/47/robotized-inclinometric-system*

CPIABOT

 # Record card: 48

Thematic areas

Tourism, social sciences and cultural heritage / Education & learning
ICT & Electronics / Artificial Intelligence
ICT & Electronics / IT and Telematics applications
ICT & Electronics / Multimedia
Tourism, social sciences and cultural heritage / Socio-economic models
Tourism, social sciences and cultural heritage / Multimedia technologies

Description

CPIAbot is a conversational assistant supporting the learning of Italian L2 for migrants. It has been tested in particular in the context of CPIA - Centri Provinciali per l'Istruzione degli Adulti - MIUR. The project was developed by the ITD-CNR in collaboration with a) PhD in Digital Humanities University of Genoa; b) Department of Modern Languages and Culture University of Genoa; c) CPIA Genoa Centre East and CPIA Genoa Centre West (MIUR). The multimodal chatbot, realised on the Telegram app, has primitive functions and multi-day dialogues (for the exercise of the four skills and communicative competence). The system meets the language needs of the migrant population in Italy: literacy and development of communicative competence. In the context of the CPIA PreA1/A1 courses, the experimentation activity concerned the monitoring of the use of CPIAbot in lessons and the co-construction of various chatbot functions with teachers concerning the co-design of chatbot dialogues and the creation of linguistic/didactic content.

Type of innovation: Product / process innovation in integration with an already existing technology

Description of innovative features / Competitive advantages

CPIAbot is a multimodal chatbot, which allows written and voice interaction with learners and teachers. Compared to many mobile language learning apps with GUI-type UX/UI, the main innovative aspect is the language-first approach, whereby the learner, instead of using a GUI/webtype interface, speaks and writes with a conversational agent, with whom he/she can experience simple conversations in Italian. Secondly, the application acts as an intermediary agent with the students, allowing teachers, with a natural language interface, to send messages and exercises to be done to single students or whole classes, remotely controlling learning through simple chat commands.

Reference market: Impacts on existing markets, Creation of new markets

Development stage: Prototype

TRL: 7

Advantages: New product/process/service/technology

Patentable technology: No

Patented technology: No

Publication of technology: In publication phase

Technology validation/demonstration: External validation

Market positioning: Italian

Partner required: Enterprise, Cooperation in national /european / international project

Key words: Virtual assistant / multimodal chatbot, Conversational agent, L2 Italian language learning, Mobile Assisted Language Learning

Url: *https://promott.cnr.it/en/technology/48/cpiabot*

PILOT SCALE PRODUCTION OF NON-IMMUNOGENIC SOLUBLE GLUTEN FOR THE PREPARATION OF DIET-THERAPEUTIC FOODS

 # Record card: 49

Thematic areas

Health & Biotech / New therapies

Agrifood / Nutrition & health

Description

Celiac disease and non-celiac gluten sensitivity affect a large portion of the world population. Furthermore, the percentage of people who adopt the gluten free diet is constantly increasing because it is perceived to be healthier. We have previously developed a food grade enzymatic procedure (transamidation) for wheat flour capable of making gluten unable to induce the inflammatory response in the intestine of celiac disease patients. Following the enzymatic treatment, gluten becomes soluble but maintains unaltered its most important technological properties, including the ability to develop the classic network in the dough, thus retaining the gas produced during leavening. The production procedure has recently been scaled on a pilot scale, allowing the preparation of innovative gluten-free prototypes, including bread based on soluble transamidated gluten mixed with rice our without technological adjuvants.

Type of innovation: Product innovation, Process innovation

Description of innovative features / Competitive advantages

The use of transamidated soluble gluten in mixture with rice flour allows the production of innovative gluten-free baked goods characterized by fragrance and flavor more similar to wheat. The nutritional aspect of these products is particularly beneficial as these ones do not require additives and are characterized by a high content of lysine, an essential amino acid normally scarce in cereals. Another interesting application of transamidated soluble gluten is as basis for an innovative vegetable milk with a wheat flavor and high protein content, available for everyone including intolerant subjects.

Reference market: Total innovation, Impacts on existing markets

Development stage: Prototype

TRL: 7

Advantages: New product/process/service/technology

Patentable technology: No

Patented technology: Yes

Country/ies: Italy, EPO, Canada, USA

Publication of technology: Published

Technology validation/demonstration: External validation

Market positioning: Italian, European, International

Partner required: Enterprise

Key words: Celiac disease, Gluten, Transamidation, Gluten-free food

Url: *https://promott.cnr.it/en/technology/49/pilot-scale-production-of-non-immunogenic-solublegluten-for-the-preparation-of-diet*

POLYMERIC CRYOGEL FOR THE REMOVAL OF HEPARINS AND HEPARINOIDS FROM AQUEOUS SOLUTIONS, PHYSIOLOGICAL SOLUTIONS AND BIOLOGICAL FLUIDS

 # Record card: 50

Thematic areas

Chemicals & Physics / Separation technologies

Health & Biotech / Medical Device

Materials / Plastics, polymers

Description

This technology describes the synthesis of cross-linked polymeric materials in the form of macroporous gels based on poly (2-hydroxyethyl methacrylate), capable of sequestering the anticoagulant heparin from aqueous solutions, physiological solutions and biological fluids. They are morphologically elastic and mechanically stable materials and show high specificity and selectivity for heparin as demonstrated by the negligible adsorption of specific blood proteins such as antithrombin III, albumin and total proteins. Preliminary tests to assess blood compatibility have also shown that macroporous hydrogels do not activate hemolysis, complement C3 and do not interfere with leukocyte and platelet counts. For these properties they could find a real application in the development of blood filters useful in surgery and dialysis to restore normal coagulation parameters after the use of heparin. The development of such devices could make more controllable the hemorrhagic events occasionally occurring during major surgeries, and, for patients that undergo to hemodialysis, could limit the onset of diseases caused by chronic use of heparin.

Type of innovation: Product innovation

Description of innovative features / Competitive advantages

The development of these filters could bring significant improvements to the safety and quality of life of patients who undergo the anticoagulant. Assuming the insertion of a hypothetical neutralizing filter in the circuit of the extracorporeal circulation machine, before the blood re-enters the circulation, the side effects and hemorrhagic risks could be eliminated. Moreover, also the risks due to protamine administration, the only antidote to heparin currently used, would be avoided. In fact, to the best of our knowledge, despite the numerous efforts evidenced by the dedicated literature, coagulation control is still regulated by protocols that afford the use of protamine. The only device, recently marketed, which allows the correct execution of dialysis using lower doses of heparin, is a dialyzer consisting of a heparinized membrane, whose use is reserved only for patients with a high risk of bleeding. The hypothetical filter proposed, also due to the low cost of the raw materials, could be developed as a disposable device, and usually be placed side by side with machines for extracorporeal blood circulation.

Reference market: Total innovation, Impacts on existing markets

Development stage: Feasibility

TRL: 4

Advantages: New product/process/service/technology

Patented technology: Yes

Country/ies: Italy, EPO, USA

Market positioning: Italian, European, International

Partner required: Enterprise, Private research center

Key words: Heparin antagonist, Polymeric cryogels, Medical device, Coagulation control, Dialysis

Url: *https://promott.cnr.it/en/technology/50/polymeric-cryogel-for-the-removal-of-heparins-andheparinoids-from-aqueous-solutions*

SOLVER - DIETARY SUPPLEMENTS TO PROTECT FROM THE HARMFUL EFFECTS OF ENVIRONMENTAL MICROPOLLUTANTS

 # Record card: 51

Thematic areas

Agrifood / Nutrition & health

Description

Environmental contamination is a prominent topic. Where the exposure to contaminants such as heavy metals (HMs) or polycyclic aromatic hydrocarbons (PAHs) is greater, the incidence of chronic degenerative diseases, such as oncologic, is increased. Scientific evidence reports that some phytochemicals are able to interact with HMs and PAHs by interfering with their cellular metabolism, inhibiting their cytotoxic mechanisms or helping to reduce tissue concentrations. In this context arise the idea of a formulation of phytochemicals to employ as bioactive ingredients in the production of a supplement that can contribute to the prevention of chronic-degenerative diseases linked to the exposure to HMs and PAHs both in populations residing in areas affected by the environmental pollution problem and, in general, in sensitive subjects. Based on an accurate literature study and in vitro experimental data, a certain number of compounds have been selected, whose combination will allow the design of an optimal nutraceutical formulation based on the physico-chemical and biological characteristics of the selected molecules. The use of phytochemicals at non-pharmacological concentrations can help reduce the bioaccumulation and toxicity of organic and inorganic micropollutants, bringing beneficial effects to health.

Type of innovation: Product innovation

Description of innovative features / Competitive advantages

The technology proposes the realization of a prototype of a dietary supplement able to contribute to the prevention of diseases in populations exposed to concentrations of environmental micropollutants higher than the national average. The formulation is the result of experimental evidence and scientific literature data processed with a bioinformatic approach and data mining. In addition, the prototype will take into account the history of use in the nutritional eld of the selected compounds, their safety pro le and the availability of supply. There is scientific evidence that reports the potential role of compounds and / or extracts against different micropollutants, however, from an initial analysis, the nutraceutical market does not show the presence of products with these application purposes.

Reference market: Total innovation, Impacts on existing markets

Development stage: Feasibility

TRL: 3, 4

Advantages: New product/process/service/technology

Patentable technology: Yes

Patented technology: No

Publication of technology: No

Market positioning: Italian, European, International

Partner required: Enterprise, Seed capital, Cooperation in national /european / international project

Key words: Dietary supplement, Nutraceuticals, Prevention, Micropollutants

Url: *https://promott.cnr.it/en/technology/51/solver-dietary-supplements-to-protect-from-theharmful-effects-of-environmental*

FABRICATION OF SILICON NANOWIRES DECORATED WITH METAL NANOSTRUCTURES/ THIN FILMS

 # Record card: 52

Thematic areas

Health & Biotech / Nanomedicine - Health & Biotech / Diagnostic, Medical imaging & advanced bioimaging - Health & Biotech / Biosensors - Health & Biotech / Micro and nanotechnology related to biological sciences - Health & Biotech / Medical imaging & equipment

Health & Biotech / Smart Devices for Health and Wellness - Materials / Composite and hybrid materials - Materials / Metals & alloys - Materials / Optical materials - Materials / Processes of production & treatment of materials - Materials / Semiconductors and Superconductors

Chemicals & Physics / Micro and nanotechnology related to physical, chemical and exact sciences

ICT & Electronics / Optics & Acoustic - ICT & Electronics / Optoacustic sensors, Optoelectronic devices - ICT & Electronics / Nanotechnologies related to electronics and microelectronics

ICT & Electronics / Electronics and microelectronics - Energy and environmental sustainability / Sensory

Description

Silicon nanowires (SiNWs) are 1D structures with diameter ranging from few tens to hundreds of nanometers and length varying from few tens of nanometers to millimeters. SiNWs are fabricated in the labs of the IMM-CNR, Rome Unit, by using bottom-up technologies such as plasma enhanced chemical vapor deposition (PECVD) at low growth temperature (≤350°C), allowing the use of plastic and glassy substrates. Their electrical properties can be tuned by controlling the p/n doping during the growth. In addition, we have developed fabrication procedures allowing to decorate the SiNWs with Au or Ag nanoparticles/thin films. These composite structures have resulted very useful in biological applications for the development of micro electrode array (MEA) for the recording of extracellular signals coming from neurons/glial cells and platforms for Raman Imaging, able to amplify the IR signals coming from biomolecules (DNA, proteins etc.).

Type of innovation: Product innovation, Process innovation

Description of innovative features / Competitive advantages

The proposed structures are fabricated by using a bottom-up approach and low growth temperatures by assuring low cost of production and an effective scalability of the platform with respect similar structures obtained by means of top-down procedures, involving expensive equipment with low throughputs. These features allow a significant flexibility in the design and development of innovative devices, which integrate a reliable nanostructured interface for biosensing, diagnostics and theranostics applications.

Reference market: Total innovation, Impacts on existing markets

Development stage: Feasibility

TRL: 3

Advantages: New product/process/service/technology

Patentable technology: Yes

Patented technology: No

Technology validation/demonstration: Internal validation

Market positioning: Italian, European, International

Partner required: Enterprise, Public research center/university, Cooperation in national /european / international project

Key words: Silicon nanowires, metal nanostructures, Raman imaging, Microelectrode array

Url: *https://promott.cnr.it/en/technology/52/fabrication-of-silicon-nanowires-decorated-with-metalnanostructuresthin-films*

HIGH RESOLUTION RAMAN MICROSPECTROSCOPY AND FAST IMAGING

 # Record card: 53

Thematic areas

ICT & Electronics / Sensor/multi-sensor technology, instrumentation

Agrifood / Food quality & safety - ICT & Electronics / Nanotechnologies related to electronics and microelectronics - Chemicals & Physics / Inorganic substances - Chemicals & Physics / Organic substances - Chemicals & Physics / Man made fibres - Chemicals & Physics / Plastics & rubber - Chemicals & Physics / Atomic and molecular spectroscopy - Materials / Plastics, polymers - Chemicals & Physics / Imaging & image processing - Materials / Properties of materials, corrosion, degradation - Materials / Processes of production & treatment of materials - Materials / Photo-active & graphene-based materials - Chemicals & Physics / Micro and nanotechnology related to physical, chemical and exact sciences - Materials / Semiconductors and Superconductors - Health & Biotech / Smart Devices for Health and Wellness - Health & Biotech / Nanomedicine - Health & Biotech / Diagnostic, Medical imaging & advanced bioimaging - Health & Biotech / Medical Device - Energy and environmental sustainability / Pollution treatment (air, soil, water) - Health & Biotech / Biosensors - Health & Biotech / Micro and nanotechnology related to biological sciences - Health & Biotech / Medical imaging & equipment - Energy and environmental sustainability / Sensory - ICT & Electronics / Electronics and microelectronics

Description

VisLab laboratory of IMM possesses a latest generation Raman micro-spectroscope equipped for vibrational measurements with high spatial and spectral resolution, at controlled temperature and in fast imaging. The apparatus can be used to collect information and chemico-physical maps without the need for sample preparation and alteration, therefore for non-destructive studies and in operating conditions. Possible applications include: identification of microplastics and pollutants (also on solutions, by vacuum filtering), biomedical diagnostics (molecules, cells and tissues), biosensing and bioanalytics (also with SERS enhancement effects), thermography on materials and electronic devices in operative conditions, in vivo monitoring of organic systems and cells, monitoring of inorganic systems during annealing, control of degradation processes, identification of pigments and dopants.

Type of innovation: Service/know how innovation

Description of innovative features / Competitive advantages

The main advantages of the system are the remarkable precision of positioning and repositioning of the motorized stage of the microscope, therefore the spatial control of the measurement, and the ability to exploit high sensitivity collection systems of the diffused optical signal to allow high speed detection, therefore an extremely rapid mapping of samples and devices. In this way, it is possible to follow in real time processes of variation of the chemico-physical properties of the samples, to identify areas of interest on large samples, or to modify in a controlled way the measurement conditions of surfaces and devices. In addition, the VisLab laboratory has skills related to the multivariate analysis of spectral data, for the extraction and processing of statistical information on the samples under study.

Reference market: Impacts on existing markets

Development stage: Industrialization

TRL: 8

Advantages: Product/process/service/technology optimization

Patentable technology: No

Patented technology: No

Publication of technology: Published

Technology validation/demonstration: External validation

Market positioning: Italian, European

Partner required: Enterprise, Public research center/university, Private research center, Cooperation in national /european / international project

Key words: Vibrational microspectroscopy, Imaging, Raman thermography, Diagnostics, sensors

Url: *https://promott.cnr.it/en/technology/53/high-resolution-raman-microspectroscopy-and-fastimaging*

HOP WASTES BIOACTIVE COMPOUNDS TO EXTEND FOURTH RANGE PRODUCT SHELF LIFE

 # Record card: 54

Thematic areas

Bioeconomy - Additive and advanced industrial manufacturing / Packaging
Agrifood / Agriculture - Agrifood / Nutrition & health - Agrifood / Food quality & safety - Chemicals & Physics / Sustainable substances and green chemistry - Energy and environmental sustainability / Waste management - Health & Biotech / Care, Hygiene, Cosmetics

Description

In the last years, hop culture has spread throughout Italy, and the vegetative biomass disposal, after harvesting of cones, used for beer production, became a serious problem for hop growers. Hop plant contains in all parts, cones, shoots, leaves and roots, bioactive compounds, with proven and important antiviral, antibacterial and antioxidant properties. Thanking to these properties, bioactive compounds extracted from hop vegetative biomass can be used for food storage and/or as a food supplement and/or as a constituent of cosmetic formulations or in the functionalization of innovative packaging. Given these premises, from a circular economy perspective, the main idea of the project is to convert a waste in a resource, making, at the same time, hop cultivation more sustainable.

Type of innovation: Product innovation

Description of innovative features / Competitive advantages

The commercial product to be obtained, following a preliminary study, is a spray formulation containing dilutions of the hop waste bioactive extracts, with promising and proven antioxidant, antimicrobial and nutritional properties. The spray would have important and innovative applications as a natural preservative to extend the shelf-life of food products (green additive or functional ingredient), improving the quality and healthiness of the product. Furthermore, given its technical characteristics, this extract may be used as a nutraceutical component for food supplements and/or as an ingredient for cosmetic products and/or in the functionalization of active packaging for food. The final product will therefore be sustainable for the environment and safe for the consumer because of natural origin. Finally, the added value of the technological proposal is the resolution of the 'hop vegetative biomass disposal' problem, that will be converted into a new resource for the producers.

Reference market: Incremental innovation, Impacts on existing markets

Development stage: Idea

TRL: 1, 2

Advantages: New product/process/service/technology

Patented technology: No

Publication of technology: No

Market positioning: Italian, European, International

Partner required: Seed capital, Cooperation in national /european / international project

Key words: Bioactive compounds, Circular economy, Hops, Food preservative, Nutraceuticals

Url: *https://promott.cnr.it/en/technology/54/hop-wastes-bioactive-compounds-to-extend-fourthrange-product-shelf-life*

GATE-CONTROLLED SUPERCONDUCTING IMPEDANCE

 # Record card: 55

Thematic areas

ICT & Electronics / Cybersecurity
ICT & Electronics / Network technology, network security
ICT & Electronics / Future Internet
ICT & Electronics / Big Data
ICT & Electronics / Artificial Intelligence
ICT & Electronics / Nanotechnologies related to electronics and microelectronics
ICT & Electronics / Electronics and microelectronics
ICT & Electronics / IT and Telematics applications
ICT & Electronics / Microwaves and RF
ICT & Electronics / Telecommunications
Aerospace and Earth Science / Satellite technologies

Description

The constant demand for more powerful and energy-efficient electronic devices than existing ones is challenging scientists and companies to develop innovative solutions that can address such primary technological needs. Based on a recent scientific discovery made by our team we have developed a technology for superfast and extremely scalable logic and computing circuits with minimal energy losses, which has the potential to become the leading technology in the future world of largescale computing and telecommunication infrastructures. Our devices have speed (in terms of operation frequency) up to a hundred times higher and energy consumption up to 100 times smaller lower than conventional semiconductor devices currently used in supercomputers and telecommunications.

Type of innovation: Process innovation

Description of innovative features / Competitive advantages

Devices made with our superconducting technology promise an operating frequency of up to 1 THz, which is about 100 times faster than current products, and greater energy efficiency. It will be possible, for the same operation, to dissipate between one tenth and one hundredth of the energy currently used. Now, there are no products with similar performance on the market, both in the world of semiconductors and in that of superconductors.

Reference market: Incremental innovation, Impacts on existing markets

Development stage: Feasibility

TRL: 2, 3

Advantages: New product/process/service/technology

Patentable technology: Yes

Patented technology: No

Market positioning: Italian, European, International

Partner required: Enterprise, Seed capital, Cooperation in national /european / international project

Key words: Impendance, Superconductor, Field-effect, Gate-controlled

Url: *https://promott.cnr.it/en/technology/55/gate-controlled-superconducting-impedance*

LIGHTWEIGHT AND HIGH-QUALITY MIRRORS, RESISTANT TO VIBRATIONS AND THERMAL CYCLING, FOR APPLICATIONS IN SPACE, AERONAUTICS AND HARSH ENVIRONMENTS

 # Record card: 56

Thematic areas

Aerospace and Earth Science / Aeronautical technologies and avionics
Aerospace and Earth Science / Satellite technologies
Additive and advanced industrial manufacturing / Additive manufacturing processes and materials
Materials / Composite and hybrid materials
Materials / Optical materials

Description

Mirrors for space applications, besides featuring suitable optical properties, should be light, resistant to mechanical stresses, and unsensitive to light-shadow thermal cycling. The standard optical materials easily fulfill optical and thermal requirements, but are fragile, and the mirrors must be thick (typically 1/6 of the diameter). For this reason, they are heavy, and the only available solution is to lighten them, by removing material from the back side, still preserving the necessary mechanical robustness and optical quality. The attempts of realizing carbon fiber mirrors didn't yield sufficient optical quality. The proposed technology aims to overcome these limitations, introducing a new composite material for mirrors. In addition to space applications, it could be adopted in those scenarios featuring strong mechanical and thermal stresses.

Type of innovation: Product innovation

Description of innovative features / Competitive advantages

We propose a new kind of optical material which, while preserving first-class optical quality, features light weight and outstanding mechanical and thermal properties, suitable for very harsh environments. Space optics is an already mature technological sector. A possible improvement is to make it cheaper to deploy optical devices in space, by reducing their weight. A mirror, even only 50 cm diameter, has a weight of tens of kg. By taking into account that the "shipping" price is 20-40 k€/kg, the advantage of reducing weight down to a few kg is straightforward. The proposed material is also suitable for both aeronautical and terrestrial applications, when strong mechanical stresses and thermal excursions occur.

Reference market: Incremental innovation, Impacts on existing markets

Development stage: Feasibility

TRL: 3, 4

Advantages: New product/process/service/technology, Cost reduction

Patentable technology: Yes

Patented technology: No

Publication of technology: No

Technology validation/demonstration: Internal validation

Market positioning: Italian, European, International

Partner required: Enterprise, Private research center, Seed capital, Cooperation in national /european / international project

Key words: Light mirrors, Optical materials, Harsh environments, Space optics, Composite materials

Url: *https://promott.cnr.it/en/technology/56/lightweight-and-high-quality-mirrors-resistant-tovibrations-and-thermal-cycling-for*

FUNCTIONALLY SELECTIVE BIOINERT MULTI-DOMAIN CERAMIC COMPOSITES FOR DENTAL IMPLANTS AND PROSTHESES

 # Record card: 57

Thematic areas

Health & Biotech / Bio-medicals

Materials / Ceramic materials

Materials / Composite and hybrid materials

Description

Inert biomedical devices with modular load-bearing function designed with peculiar multi-domain composite microstructures. The reference compositional system is Zirconia-Alumina with a prevailing overall composition of customizable zirconia or alumina. Examples of devices are 3D structures consisting of parts with differentiated functional properties, due to different composition/microstructure/architecture, and further functionalizable ex-post to favor and improve the stabilization of the implantation by newly formed bone in superior quantity and quality. The dual composite microstructure is applicable for other structurally load-bearing devices that require lightness, wear resistance and capable of blocking the aggression of relevant chemical environments.

Type of innovation: Product innovation

Description of innovative features / Competitive advantages

The peculiar multi-domain composite microstructure is capable of modulating properties normally interfering with each other: flexural strength - fracture toughness; stiffness - hardness; ageing. It is therefore able to confer, for example, differentiated and differentiable mechanical properties on the basis of the compositional and granulometric ranges, selected both for the matrix and for the dispersed phase and their relative quantities. The fabrication process of such architecture was developed with conventional methods and commercial raw materials, both at reduced costs. It's potentially realizable using rapid prototyping technique. Integrity and continuity at the interface between parts with different composition and properties, have been obtained. The differentiability of the compositional ranges expands without apparent limits the expandability of these composites to applications beyond the biomedical one so far taken into greater consideration.

Reference market: Incremental innovation, Impacts on existing markets, Creation of new markets

Development stage: Feasibility

TRL: 2, 3

Advantages: New product/process/service/technology, Product/process/service/technology optimization

Patentable technology: Yes

Patented technology: No

Publication of technology: No

Market positioning: Italian, European, International Private research center, Seed capital, Cooperation in national /European /international project

Key words: Zirconia, Allumina, Dental implant, Prosthesis, Functional properties, Multi-domain composite

Url: *https://promott.cnr.it/en/technology/57/functionally-selective-bioinert-multi-domain-ceramiccomposites-for-dental-implants*

COUPLED STIRLING ENGINE/FLUIDIZED BED COMBUSTOR FOR MICRO-DISTRIBUTED ENERGY PRODUCTION FROM BIOMASS

 # Record card: 58

Thematic areas

Energy and environmental sustainability / Renewable sources

Energy and environmental sustainability / Energy production, transmission and conversion

Description

A distributed micro-cogeneration system has been developed for continuous and programmable autonomous production of thermal (between 25 and 70 kW_{th}) and electrical (between 5 and 10 kW_{el}) energy starting from heterogeneous biomasses. A global thermal efficiency greater than 80%, the availability of electricity and thermal energy h24h 365g / year in every not-desert region of the world, even the most remote, ultra-low levels of emissions of solid and gaseous pollutants and the possibility of feeding with different types of biomass, mainly of vegetable origin, are the benchmarks of expected performance.

It is based on an innovative coupling scheme between a fluidized bed combustor and a Stirling engine which sees the engine exchanger directly immersed in the bed. This determines an extremely efficient heat exchange and eliminates the problems of exchanger fouling that afflict all systems based on traditional boilers and exchangers immersed in the exhaust gas stream.

Type of innovation: Product / process innovation in integration with an already existing technology

Description of innovative features / Competitive advantages

The micro-generators from traditional renewable sources (for example photovoltaic, wind, solar thermal and thermodynamic), do not provide energy in a continuous and programmable way unless coupling expensive and problematic storage systems (such as batteries and thermal storage) and are rarely co-generators. The proposed system possesses all these features. Fluidized bed combustors allow the use of self-produced residual biomass or available at zero km with simple pre-treatments and therefore, like other alternative sources, of very low or even negative cost (savings on disposal costs). Biomass can be stored for very long times in easy to build deposits. These features, together with the high strength, low noise and reduced maintenance of the Stirling engines, result in a competitive overall cost of operation. The markets having very high potential are in the residential, agro-industrial and service sectors and in the energy self-sufficiency of underdeveloped regions.

Reference market: Impacts on existing markets

Development stage: Prototype

TRL: 6

Advantages: Product/process/service/technology optimization

Patented technology: No

Technology validation/demonstration: Internal validation

Market positioning: Italian, European, International Enterprise, Cooperation in national /European / international project

Key words: Distributed micro-cogeneration, Biomass, Renewable source, Ultra-low emissions of pollutants, Programmable and on-demand generation

Url: *https://promott.cnr.it/en/technology/58/coupled-stirling-engine uidized-bed-combustor-formicro-distributed-energy*

PROTOTYPE OF AUTOMATIC SMART IRRIGATION SYSTEM

 # Record card: 59

Thematic areas

Agrifood / Agriculture

Energy and environmental sustainability / Environmental engineering/technologies ICT & Electronics / Internet of Things

Description

The prototype uses soil moisture sensors which, through a measurement of dielectric permittivity, estimate the soil moisture based on which irrigation is started through relay-controlled solenoid valve. The system was developed using Open-Source technologies. Specifically, for the hardware components, a small sized board computer Raspberry PI 3B + was used together with a 4G LTE Wi-Fi router and a Modbus rs485 / USB converter. The data storage and management system are based on a NOSQL-type Elastic stack and a Grafana-based dashboard. Specific Python scripts have been developed for the acquisition of data from the probes and for the activation of the solenoid valve. The system thus composed can be used to remotely manage any sensor / probe that does not have proprietary hardware and software technologies.

Type of innovation: Product / process innovation in integration with an already existing technology

Description of innovative features / Competitive advantages

The innovative features are given using Open-Source technologies for the acquisition and data management in precision irrigation. The system is advantageous as it is relatively inexpensive compared to commercial solutions and because it is not subject to the vendor lock-in. In addition, the modular system is easily adaptable to various application fields.

Reference market: Incremental innovation, Impacts on existing markets

Development stage: Prototype

TRL: 6, 7

Advantages: New product/process/service/technology, Product/process/service/technology optimization, Cost reduction

Patentable technology: No

Patented technology: No

Publication of technology: In publication phase

Technology validation/demonstration: External validation

Market positioning: Italian, European, International

Partner required: Enterprise, Seed capital, Cooperation in national /European / international project

Key words: Raspberry Pi , Internet of Things, Open Source, Precision irrigation, Remote irrigation

Url: *https://promott.cnr.it/en/technology/59/prototype-of-automatic-smart-irrigation-system*

LOW COST, COMPACT & PORTABLE SYSTEM FOR REMOTE IN SITU FLUID UV ABSORBANCE ANALYSES

 # Record card: 60

Thematic areas

Energy and environmental sustainability / Environmental engineering/technologies - ICT & Electronics / Sensor/multi-sensor technology, instrumentation - Energy and environmental sustainability / Sensory
Agrifood / Agriculture - ICT & Electronics / Internet of Things - Agrifood / Food quality & safety - Energy and environmental sustainability / Pollution treatment (air, soil, water)

Description

We propose a compact innovative spectroscopy system operating in the UV range. In the actual version, designed for gas, it exhibits: an aluminum tubular optical chamber (length can be adjusted; currently is 20 cm); a cheap commercial UV LED; a SiC visible blind UV detector designed and manufactured at the CNR-IMM facilities. The team developed also the electronic chain for wireless remote real time read out; while able to deal with pA current levels, it uses very cheap components and construction technology. The system could be used for liquid analysis by opportune chamber modification. It could fit in: water quality (monitoring dissolved elements and micro-organisms exploiting the UV absorption/fluorescence of DNA and proteins); concentration measurements of gases such as SO2, NOx, H2S and ozone. Whilst such analyses are performed with high accuracy in laboratories, it would be highly beneficial to have portable system for in- eld real-time measurements. The first prototype was tested for concentration measurements of SO2, a gas of particular interest in volcanic monitoring, obtaining a resolution ≤ 2 ppm.

Business fields: Agrifood

Type of innovation: Product / process innovation in integration with an already existing technology

Description of innovative features / Competitive advantages

Innovative characteristics are: low cost; compactness (compared to lab. equipment) allowing in situ measurements; remote control and data acquisition. It is in fact a solid-state apparatus with cheap commercial LED source and a large area, high sensitivity and low dark current UV visible blind SiC detector. All these features ensure: short optical path (≤ 20 cm in the case of SO2 detection) adjustable according to the application; low power consumption; very high detection ability. Adopting SiC visible blind detector, fakes due to photoemission in the visible of chemical interfering are excluded. Moreover, detector thermal stability reduces the number of free parameters during the measurements in particular in hostile environments. Competitive advantages of the portable spectrometer are its robustness and insensitivity to environmental temperature and humidity. In the specific case of SO2 detection for example, compared to electrochemical sensors commonly used for this application, it does not present chemical saturation problems, nor require periodic re-calibration and a long life is expected also in a hostile environment such as volcanic one.

Reference market: Incremental innovation, Creation of new markets

Development stage: Prototype

TRL: 4

Advantages: Product/process/service/technology optimization, Cost reduction

Patentable technology: No

Patented technology: No

Technology validation/demonstration: External validation

Market positioning: Italian, European, International

Partner required: Enterprise, Public research center/university, Private research center, Cooperation in national /european / international project

Key words: UV portable spectrometry, Gas monitoring, SO2 sensor, Microorganism detection in fluid, Air and water quality monitoring

Url: *https://promott.cnr.it/en/technology/60/low-cost-compact-portable-system-for-remote-in-situuid-uv-absorbance-analyses*

COMPACT-GC: MEMS-BASED GAS-CHROMATOGRAPHIC PLATFORM

 # Record card: 61

Thematic areas

Tourism, social sciences and cultural heritage / Archeometry - Energy and environmental sustainability / Safety and security - ICT & Electronics / Sensor/multi-sensor technology, instrumentation - Materials / Processes of production & treatment of materials - Health & Biotech / Smart Devices for Health and Wellness
Agrifood / Food quality & safety - Energy and environmental sustainability / Energy production, transmission and conversion - Energy and environmental sustainability / Cleaner use of fossil fuels
Tourism, social sciences and cultural heritage / Safety and security - ICT & Electronics / Nanotechnologies related to electronics and microelectronics - Energy and environmental sustainability / Environmental engineering/technologies - Additive and advanced industrial manufacturing / Process control and logistic
Energy and environmental sustainability / Sensory - ICT & Electronics / Electronics and microelectronics
Chemicals & Physics / Separation technologies

Description

The compact-GC platform is a MEMS-based analytical module for the purge&trap preconcentration and (gas)-chromatographic separation of a sample. The two analytical MEMS (preconcentrator and GC column) are interconnected by means of a MEMS micro fluidic manifold. The micro fluidic manifold interconnects the analytical MEMS, but it also acts as injector through the integrated micro-valves. The main characteristics of the invention, namely the wide adoption of MEMS technology and the system integration solutions adopted, enable the operation of the entire system at high temperature (above 200°C), as necessary for the analysis of a wide range of substances, from volatile to high-boiling compounds. The system is miniaturized, robust, low-cost and efficient, both in terms of power consumption and of consumables. The compact-GC module can be coupled to a wide range of detectors.

Type of innovation: Product / process innovation in integration with an already existing technology, Service/know how innovation

Description of innovative features / Competitive advantages

Compared to other miniaturized and/or MEMS GC systems, this innovation combines the purge&trap enrichment functionality with GC separation, thus increasing both the sensitivity and the selectivity of the analysis on a wide range of samples. The main competitive advantages are thus relative to the versatility, meaning the applicability, of the gas-chromatographic analysis to different use scenarios. The miniaturized MEMS implementation is particularly suitable for the assembly of portable equipment for in- eld analyses. Furthermore, the compact-GC platform is flexible and rapidly re-configurable for the use of different injector types (purge&trap, loop) and different types of GC columns (packed, FAST-GC). The detector is not a part of the platform, since compact-GC is compatible with a wide range of detectors, both commercially available (PID, FID, TCD) and innovative (IMS, QEPAS, micro-PDD).

Reference market: Incremental innovation

Development stage: Prototype

TRL: 6

Advantages: Product/process/service/technology optimization

Patented technology: Yes

Country/ies: Italy, PCT

Publication of technology: Published

Technology validation/demonstration: Internal validation

Market positioning: Italian, European, International

Partner required: Enterprise, Cooperation in national /european / international project

Key words: MEMS, Gas-chromatography, Chemical analysis, Portable system, General purpose

Url: *https://promott.cnr.it/en/technology/61/compact-gc-mems-based-gas-chromatographicplatform*

GC/QEPAS: GAS CHROMATOGRAPHY COUPLED TO PHOTOACOUSTIC SPECTROSCOPY

 # Record card: 62

Thematic areas

Tourism, social sciences and cultural heritage / Archeometry - Tourism, social sciences and cultural heritage / Safety and security - ICT & Electronics / Sensor/multi-sensor technology, instrumentation
ICT & Electronics / Optics & Acoustic - ICT & Electronics / Smart cities and Communities
ICT & Electronics / Robotics and control systems - ICT & Electronics / Optoacustic sensors, Optoelectronic devices - Additive and advanced industrial manufacturing / Process control and logistic
Chemicals & Physics / Separation technologies - Additive and advanced industrial manufacturing / Factory of the Future - Chemicals & Physics / Atomic and molecular spectroscopy - Health & Biotech / Smart Devices for Health and Wellness - Health & Biotech / Diagnostic, Medical imaging & advanced bioimaging
Energy and environmental sustainability / Safety and security - Health & Biotech / Medical Device
Energy and environmental sustainability / Natural disasters - Energy and environmental sustainability / Pollution treatment (air, soil, water) - Energy and environmental sustainability / Sensory
Measurement tools and Standards - ICT & Electronics / Electronics and microelectronics

Description

We propose a portable chemical analysis system capable of identifying chemical substances at trace concentrations (sub-ppm), even in case of a complex matrix of interfering species. This is achieved by means of the bi-dimensional selectivity obtained through the combination of gaschromatographic (GC) separation and photoacoustic (PA) infrared analysis, in particular quartzenhanced PA spectroscopy (QEPAS). The GC module is preferentially a MEMS-based FAST-GC device, capable of separating complex and low volatility samples within a short time (few minutes) and on a reduced thermal budget. The QEPAS module is preferentially built around an analysis cell with a microscopic internal volume, capable of processing, with high sensitivity and excellent selectivity very small vapor flows, as typically eluting from a FAST-GC column.

Type of innovation: Product innovation

Description of innovative features / Competitive advantages

The GC/QEPAS system is a high-end vapor analysis system, relying on the bi-dimensional selectivity of gas-chromatographic separation coupled to a spectroscopic detector. While such combination is already frequently used in laboratory equipment, most notably as GC/MS (gaschromatography and mass spectroscopy), those systems are complex, expensive and not suitable for portable implementations or in- eld analyses, mainly due to the fragility of the ultra-high vacuum pumps necessary for the MS system. The combination of a MEMS-based FAST-GC system with a specifically designed infrared absorption spectroscopy system enables sensing performances similar to GC/MS systems, but in a miniaturized, portable and robust systems. This technology is suitable to rapidly detect in- eld specific substances at trace concentrations, even inside a complex interfering sample matrix.

Reference market: Impacts on existing markets

Development stage: Prototype

TRL: 6

Advantages: New product/process/service/technology, Cost reduction

Patented technology: Yes

Country/ies: Italy, PCT

Technology validation/demonstration: External validation

Market positioning: Italian, European, International

Partner required: Enterprise, Seed capital

Key words: MEMS, Gas-chromatography, Photoacoustic spectroscopy, Portable system, In-field analyses

Url: *https://promott.cnr.it/en/technology/62/gcqepas-gas-chromatography-coupled-tophotoacoustic-spectroscopy*

LONG NON-CODING RNAS AS BIOMARKERS AND THERAPEUTIC TARGETS IN MEDULLOBLASTOMA

 # Record card: 63

Thematic areas

Health & Biotech / New therapies

Description

Integrative omics has posed new challenges in modern precision medicine, particularly in oncology, including i) the identification of new tumor markers for early, precise, and non-invasive diagnostics, and ii) the discovery of innovative molecular targets for therapeutic applications. Our studies on medulloblastoma, a highly malignant childhood tumor, have contributed to identifying RNA molecules that meet these criteria. These are long non-coding RNAs, transcripts without the ability to produce proteins but crucial in regulating biological processes and involved in tumor initiation and progression. Through experimental analyses in tumor cell lines and assessments of their levels in primary tumors, we identified RNAs that are aberrantly expressed in medulloblastoma compared to healthy tissue. Further molecular characterizations have led us to conclude that these RNAs serve as new biomarkers for stratifying the various subgroups of medulloblastoma and as potential targets for targeted therapy.

Type of innovation: Product innovation

Description of innovative features / Competitive advantages

The long non-coding RNAs we have identified in various medulloblastoma subgroups possess molecular characteristics that make them superior tumor biomarkers compared to "canonical" transcripts. The tumor-specific expression pattern enables early diagnosis not only of the tumor type but also of the tumor subgroup, facilitating targeted therapies. In general, the increase in their expression levels correlated with the severity of the tumor can provide prognostic information regarding the tumor stage. Their high stability in bodily fluids makes them excellent candidates for non-invasive screening compared to current biopsies. From a therapeutic perspective, based on their specificity and functional versatility, long non-coding RNAs can represent optimal and easily targetable therapeutic substrates, for example, through the development of RNA-based drugs. We have identified modified antisense oligonucleotides capable of recognizing and silencing, through base complementarity, overexpressed long non-coding RNAs in the pathology. Restoring their expression to physiological levels allows for the recovery of molecular cascade patterns deregulated by the transcript and for the mitigation of tumor characteristics in vitro.

Reference market: Total innovation, Impacts on existing markets

Development stage: Idea

TRL: 2

Advantages: New product/process/service/technology

Patentable technology: Yes

Patented technology: No

Technology validation/demonstration: Internal validation

Market positioning: Italian, European, International

Partner required: Enterprise, Public research center/university, Private research center, Cooperation in national /european / international project

Key words: Medulloblastoma, Long noncoding RNAs, Tumour biomarkers, Therapeutic targets, Personalized theranostics

Url: *https://promott.cnr.it/en/technology/63/long-non-coding-rnas-as-biomarkers-and-therapeutictargets-in-medulloblastoma*

SYSTEM AND METHOD FOR CONTROLLING THE MOBILITY OF VEHICLES OR PEDESTRIANS

 # Record card: 64

Thematic areas

Automotive transport and logistics / Traffic control systems - ICT & Electronics / Sensor/multi-sensor technology, instrumentation - ICT & Electronics / Optics & Acoustic
ICT & Electronics / Smart cities and Communities - ICT & Electronics / Big Data
ICT & Electronics / Internet of Things - ICT & Electronics / Artificial Intelligence
ICT & Electronics / Augmented Reality - ICT & Electronics / Electronics and microelectronics
ICT & Electronics / Information processing, information system, workflow management
ICT & Electronics / IT and Telematics applications - ICT & Electronics / Multimedia

Description

The technology refers to a system for the safety and control of the mobility of vehicles, pedestrians, and mass transport users, in conventional and advanced contexts and is suitable for use as an infrastructure for the production/sharing of information and data, aimed at monitoring and intervention in critical areas by offering specific functions concerning the detection of potentially dangerous situations or the optimization of resources. The technology consists of a distributed system which (in basic configuration) consists of mobile nodes installed on vehicles or associated with individual people, equipped with network devices. The radio coverage range of these devices defines "proximity areas" within which the individual nodes can communicate with each other dynamically. The system can also include fixed nodes installed at strategic points of the road network. An extended configuration also includes server nodes connected to the internet that provide additional ITS and cooperation services between different contexts.

Type of innovation: Product innovation, Service/know how innovation

Description of innovative features / Competitive advantages

The technology allows the driver of a vehicle or pedestrian access to multimedia perceptual information (in real-time) produced by remote nodes (in proximity), independent of the status, position, and direct view of the vehicle or pedestrian. For example, a driver can access a FOV that is useful for him (e.g., confluence or inside the tunnel) thanks to the information transmitted by other mobile/fixed nodes in the area of interest. Intelligent systems can exploit data flows to detect potential critical issues and allow effective integration between conventional and assisted driving. The technology can provide each node with only relevant information and dose the quantity and frequency according to the type (person/software). It also allows advanced mobile monitoring/intervention infrastructures in different contexts (e.g., monitoring structures, emergency, and rescue). The invention has simplicity of construction, moderate installation/management costs, versatility/scalability, and integrability with other systems to develop functionality in different contexts.

Reference market: Incremental innovation, Impacts on existing markets

Development stage: Prototype

TRL: 4

Advantages: New product/process/service/technology, Cost reduction

Patented technology: Yes

Country/ies: Italy, Europe

Publication of technology: Published

Technology validation/demonstration: Internal validation

Market positioning: Italian, European, International

Partner required: Enterprise, Seed capital, Cooperation in national /european / international project

Key words: Smart mobility, Safety, Monitoring, Emergency and rescue, Structural monitoring

Url: *https://promott.cnr.it/en/technology/64/system-and-method-for-controlling-the-mobility-ofvehicles-or-pedestrians*

HISTOPLAT: DEVELOPMENT OF A MULTIPARAMETRIC PLATFORM FOR OPTIMIZING THE DIAGNOSIS, PREVENTION AND THERAPY OF TUMORS RELATED TO THE DEREGULATION OF THE WNT/B-CATENIN PATHWAY

 # Record card: 65

Thematic areas

Health & Biotech / New therapies

Health & Biotech / Diagnostic, Medical imaging & advanced bioimaging

Description

The platform HistoPlat implies the development and validation of a mathematical algorithm, potentially combinable with an image analysis software, that, through a multiparametric approach including the immunohistochemical analysis of both expression and localization of multiple markers, allows the histopathologist or oncologist to optimize the diagnosis and prognosis, and to predict the clinical response to therapies directed towards validated and/or innovative molecular targets, also taking into account the individual variability of each patient. The proposed multiparametric platform includes molecular components of the Wnt/β-catenin pathway, and the CD44 as a multifunctional indicator of advanced tumor stages and metastatic disease, as well as parameters related to cell proliferation already in use in diagnostic practice (positive Ki67 and mitotic index). Furthermore, given the recently reported correlation between activation of the pathway in tumor tissue and the immune resistance mechanisms, the platform will also include the expression of immune checkpoint markers.

Type of innovation: Product / process innovation in integration with an already existing technology, Service/know how innovation

Description of innovative features / Competitive advantages

The proposed biomarkers, even if recognized by the international scientific community as crucial for the development of many tumors, are not yet used in tools diagnostic/prognostic or predictive of the therapeutic response. The multiparametric approach is currently used in diagnostic exclusively for evaluating molecular parameters but not the immunohistochemical ones.

COMPETITIVE ADVANTAGES: The multiparametric platform HistoPlat is based on the histological diagnosis and the molecular localization by immunohistochemistry, economically sustainable and hypothetically applicable to the majority of diagnostic and health care sites, both public and private. It also takes into account the individual variability of each patient and is in line with personalized medicine. Furthermore, a multiparametric approach that allows the simultaneous detection of Wnt pathway-related molecules and immune checkpoint markers could have a predictive value for the clinical response to treatments with the immune checkpoint inhibitors (ICIs) in use in the clinic, and open new perspectives for the development of new combination strategies.

Reference market: Total innovation, Incremental innovation, Impacts on existing markets, Creation of new markets

Development stage: Idea

TRL: 2

Advantages: New product/process/service/technology

Patentable technology: No

Patented technology: No

Publication of technology: No

Technology validation/demonstration: Internal validation

Market positioning: Italian

Partner required: Cooperation in national /european / international project

Key words: Multiparametric platform, Immunohistochemical analysis, Cancer diagnosis and prognosis, Cancer targeted therapy, Wnt/β-catenina pathway

Url: *https://promott.cnr.it/en/technology/65/histoplat-development-of-a-multiparametric-platformfor-optimizing-the-diagnosis*

UMANAGER - SERIOUS GAME FOR BUSINESS AND FINANCIAL EDUCATION

 # Record card: 66

Thematic areas

Tourism, social sciences and cultural heritage / Technologies for preservation of cultural heritage
Tourism, social sciences and cultural heritage / Education & learning
ICT & Electronics / Artificial Intelligence
ICT & Electronics / IT and Telematics applications
ICT & Electronics / Multimedia
Tourism, social sciences and cultural heritage / Socio-economic models
Tourism, social sciences and cultural heritage / Multimedia technologies

Description

uManager is a management game designed to foster the development of young students' entrepreneurial skills and abilities. The game offers the opportunity to manage a tourist village, stimulating the skills of decision making and problem-solving in a simulated scenario adhering to the real one. uManager is suitable for use in the classroom or at a distance, in formal and informal contexts. It is useful for PCTO (Pathways to Transversal Skills and Orientation) initiatives as it promotes immersive and experiential learning. Players can learn as if they were in a real workplace, in a fun and motivating way thanks to the correct balance between the realism offered by the simulated environment and the engagement generated by the game environment.

Type of innovation: Product / process innovation in integration with an already existing technology, Service/know how innovation

Description of innovative features/Competitive advantages

uManager offers an experiential learning environment designed to be customized and meet the specific needs of students and teachers. It is supplemented by a management and monitoring platform for teaching activities that allows the teacher to design the learning activity and adapt the path to the real needs of the class. The monitoring platform allows evaluating the effectiveness of the educational pathway through intelligent analysis of the student's activity. The educational value of uManager, verified through the research activity, opens possible scenarios of collaboration with institutions or companies in the eld of school publishing, software houses, training and career guidance services. The innovation, validated from an educational and technological point of view, is ready for transfer. The standard features of uManager are well defined but customizable and integrable according to the needs of the applicant.

Reference market: Incremental innovation, Impacts on existing markets

Development stage: Prototype

TRL: 7, 8

Advantages: New product/process/service/technology

Patentable technology: No

Patented technology: No

Publication of technology: No

Technology validation/demonstration: External validation

Market positioning: Italian, European

Partner required: Enterprise, Cooperation in national /european / international project

Key words: Educational technology, Serious game, Financial and entrepreneurial education, Simulation-based learning environment

Url: *https://promott.cnr.it/en/technology/66/umanager-serious-game-for-business-and- nancialeducation*

SEQUENTIAL ANALYSIS OF MACROMOLECULES ACCESSIBILITY (SAMMY-SEQ)

 # Record card: 67

Thematic areas

Health & Biotech / Bio-medicals

Health & Biotech / Diagnostic kits

Description

This is a high-throughput sequencing based method to map euchromatin and heterochromatin accessibility. The method is based on the sequential extraction of distinct nuclear fractions containing: soluble proteins (S1 fraction); the surnatant obtained after DNase treatment (S2 fraction); DNase-resistant chromatin extracted with high salt buffer (S3 fraction); and the most condensed and insoluble portion of chromatin, extracted with urea buffer that solubilizes the remaining proteins and membranes (S4 fraction). We further adapted the method to leverage high-throughput DNA sequencing for genome-wide mapping of the distinct chromatin fractions. The insoluble fractions are reproducibly enriched in lamina-associated heterochromatic regions (LADs), while the more soluble one correlates with euchromatin. Thus with a unique protocol we are able to describe the accessibility of euchromatin and heterochromatin.

Type of innovation: Product innovation, Process innovation, Service/know how innovation

Description of innovative features / Competitive advantages

Our protocol overcomes several major limitations of other methods for mapping lamina associated heterochromatic regions. First of all, the procedure can be applied on primary cells, as it doesn't require exogenous gene expression as in DamID-seq. Then, SAMMY-seq does not involve chemical modifications of chromatin, which might cause artifacts and biases in sequencing. Additionally, it does not rely on antibodies for enriching specific chromatin fractions, thus avoiding issues related to antibody specificity, production, lot-variability and cross reactivity. This is particularly important when studying epigenetic changes in cells where protein levels of chromatin associated factors could be altered, thus allowing more flexibility in terms of experimental design compared to antibody-based techniques. Finally, SAMMY-seq is robust, as it yields reproducible results even at lower sequencing depth or with a small number of starting cells (10K) and requires only about 3 hours of bench work, excluding DNA extraction and library preparation.

Reference market: Incremental innovation, Impacts on existing markets

Development stage: Feasibility

TRL: 3, 4

Advantages: New product/process/service/technology

Patented technology: Yes

Country/ies: Europe

Publication of technology: Published

Market positioning: Italian, European

Partner required: Enterprise, Seed capital, Cooperation in national /european / international project

Key words: Chromatin, Chromosome conformation, Genome accessibility, Epigenetics

Url: *https://promott.cnr.it/en/technology/67/sequential-analysis-of-macromolecules-accessibilitysammy-seq*

INNOVATIVE BIOINFORMATIC TOOLS FOR GENETIC DATA ANALYSIS AND INTEGRATION WITH OMICS DATA, AIMED TO THE IDENTIFICATION OF CAUSAL MECHANISMS AND THERAPEUTIC TARGETS

 # Record card: 68

Thematic areas

Health & Biotech / Bio-informatics

ICT & Electronics / Big Data

Description

In the last years, genetics played a strategic role in the identification of therapeutic targets for complex diseases. Genetic studies identified thousands of variants contributing to disease onset and/or to the influence of measurable features (phenotypes) impacting health. The mechanism of action by which they modulate diseases and phenotypes is still unknown for the vast majority. The integration of genetic and omics data, such as gene expression (transcriptomics), proteomics or gut microbiome pro les, enriched with molecular modeling and in silico druggability studies, facilitate the comprehension of these unknown mechanisms.

Exploitation of these results is a key step for selectively identifying therapeutic targets, predicting potential side effects and developing appropriate clinical trials with a higher chance of success. Our team has the necessary tools and expertise to realize the entire process.

Type of innovation: Service/know how innovation

Description of innovative features / Competitive advantages

Our research team, unique in Italy, involves researchers with expertise in: development of statistical and bioinformatic methods, analysis of big genomic data and in general omic- layers, screening and analysis of pharmacological databases, understanding of biological mechanisms regulating the immune and cardiometabolic system.

We have a long-lasting expertise in the eld, for which we are recognized at an international scale. Through the identification of the most suitable, powerful and innovative bioinformatic methods, we guarantee a significant reduction in costs and running time, while maintaining high quality.

We offer:

- Consultation for design and analysis of large scale genetic and omic studies
- Bioinformatic analyses for the identification of potential therapeutic targets through systematic assessment of public data and integration of client's/partner's private data
- Screening in-silico of new molecules for known drug targets
- Consultation for designing an optimal clinical trial.

Reference market: Impacts on existing markets

Development stage: Industrialization

TRL: 9

Patentable technology: No

Patented technology: No

Publication of technology: No

Technology validation/demonstration: External validation

Market positioning: Italian, European, International

Partner required: Enterprise, Public research center/university, Private research center, Cooperation in national /european / international project

Key words: Big data genomics, Omics integration, Drug targets screening, Clinical trials design

Url: *https://promott.cnr.it/en/technology/68/innovative-bioinformatic-tools-for-genetic-dataanalysis-and-integration-with-omics*

COMPACT SCINTIGRAPHIC DEVICE WITH MODULAR DESIGN AND HIGH SPATIAL RESOLUTION

 # Record card: 69

Thematic areas

Health & Biotech / Bio-medicals
Health & Biotech / Medical imaging & equipment
Health & Biotech / Diagnostic, Medical imaging & advanced bioimaging
Health & Biotech / Medical Device

Description

The aim of the present invention is to develop a modular scintigraphic device, with high spatial resolution, capable of creating investigation areas of various shapes and sizes, of compact form and of being used in different types of applications. In particular, all the variants proposed solve a series of problems linked to the use of the new MPPC (Multi Pixels Photon Counters) instead of the traditional phototubes and PSMPT (Position Sensitive Photo Multiplier Tube), thus making it possible to create extremely compact devices that are easier to use, especially in environments such as operating theatres and in robotic surgery. These modular structures can therefore be produced in such a way as to lower the overall costs of the devices and be suitable for introduction into important hospital environments such as operating theatres, to facilitate localisation techniques during surgery.

Type of innovation: Product / process innovation in integration with an already existing technology

Description of innovative features / Competitive advantages

The method makes it possible to use individual MPPC modules or individual SiPMs as collection anodes on which the scintillation elements can be arranged. Various versions of structures and ways of electronically connecting the modules are proposed, so that independent detection structures or a single detection structure can be realised. The detection areas can be constructed in any size and without limitation to the number of MPPC modules.

Reference market: Incremental innovation, Impacts on existing markets

Development stage: Feasibility

TRL: 2, 3

Advantages: Product/process/service/technology optimization, Cost reduction

Patented technology: Yes

Country/ies: Italy

Market positioning: Italian, European, International

Partner required: Enterprise, Seed capital, Cooperation in national /european / international project

Key words: Modular gamma camera, Flat detector, High resolution detector, Silicon photo Multiplier SiPM

Url: *https://promott.cnr.it/en/technology/69/compact-scintigraphic-device-with-modular-designand-high-spatial-resolution*

ARTIFICIAL GENES AS A THERAPEUTIC STRATEGY FOR MUSCULAR DYSTROPHIES

 # Record card: 70

Thematic areas

Health & Biotech / Bio-medicals

Health & Biotech / New therapies

Description

The technology we participate to develop, called "Zinc-Finger Artificial Transcription Factors (ZFATFs)", allows to design, realize and select artificial genes coding for proteins capable of recognizing and binding "potentially" any DNA sequence. We used ZF-ATF technology to reprogram the expression of "beneficial" genes capable of efficiently counteracting the negative effect of mutated genes related to rare diseases. In addition, we have combined ZF-ATF technology with adeno-associated vector (rAAV) technology to develop gene therapy projects applicable to Duchenne Muscular Dystrophy (DMD), Merosinopathy (MDC1A), other neuromuscular pathologies and various genetic or viral human pathologies.

Type of innovation: Product innovation

Description of innovative features / Competitive advantages

The therapeutic strategy we propose specifically for Duchenne Muscular Dystrophy (DMD) is based on artificial transcription factors Zinc Finger (ZF-ATF), addressed to the "A" promoter of the utrophin gene to up-regulate its expression. The main advantages of our ZF-ATFs over other gene therapy technologies for DMD are; i) ZF-ATFs are applicable to all DMD patients regardless of the type of mutation present in Dystrophin; ii) ZF-ATFs are active at low concentrations and due to their small size they are ideal in gene therapy; iii) ZF-ATFs are a valid alternative to the replacement of large mutated genes; iv) ZF-ATFs mimic the natural mechanism of transcription regulation, producing all the "isoforms" of the target gene product; and v) Our ZF-ATFs are designed to avoid/reduce any immune response.

Reference market: Total innovation, Impacts on existing markets

Development stage: Prototype

TRL: 4, 5

Advantages: New product/process/service/technology

Patented technology: Yes

Country/ies: Italy, EPO, USA

Technology validation/demonstration: Internal validation

Market positioning: Italian, European, International

Partner required: Enterprise, Seed capital, Cooperation in national /european / international project

Key words: Artifcial transcription factors, AAV, DMD, MDC1A, ZF-ATF

Url: *https://promott.cnr.it/en/technology/70/articial-genes-as-a-therapeutic-strategy-formuscular-dystrophies*

MYELIN NANO-VESICLES FOR THE TREATMENT OF NEUROPATHIES AND NEUROINFLAMMATORY PATHOLOGIES

 # Record card: 71

Thematic areas

Health & Biotech / Micro and nanotechnology related to biological sciences
Health & Biotech / Bio-medicals
Health & Biotech / New therapies
Health & Biotech / Nanomedicine
Health & Biotech / Development of new drugs
Agrifood / Nutrition & health

Description

Recently, nanoparticles and nanovesicles have been investigated as potential approaches for the treatment of neurodegenerative diseases. In particular, in the Biotech sector an increasingly deeper penetration of new treatment models and biological drugs based on cellular, subcellular and vesicle therapies is expected. The patent is based on the production of Myelin-based nanoVesicles (MyVes) produced by micro fluidics, starting from myelin extracted from brain tissue. These vesicles find two major elds of applications as potential drugs or as supplements/nutraceuticals.

1. MyVes: drug for the treatment of neurodegenerative diseases with a strong inflammatory component such as Multiple Sclerosis, Alzheimer's, Parkinson's etc.

MyVes, produced with innovative protocols from myelin extracted from brain tissue, have been characterized in terms of physical and biological properties. Through *in vitro*, *in vivo* and *ex-vivo* experiments we have demonstrated that MyVes:

- They are approximately 100 nm in size, negative zeta potential, contain the main proteins and lipids of the myelin sheath and are biocompatible.
- They are able to reach the Central Nervous System (CNS) via nasal administration.
- They have a specific target by targeting microglia (CNS immune cells involved in all neuro inflammatory pathologies) inducing an anti-inflammatory phenotype.
- They can be loaded with drugs or molecules with therapeutic activity and then used as a brain drug delivery system, enhancing the effects of the drug. In fact, allowing the drug to:
    - reach the brain, reducing its distribution in non-target organs
    - act on brain target cells (microglia)
    - increase its half-life and stability
    - reduce the administration dose and therefore the adverse effects
- Moreover, as they are made up of myelin, they induce an antigen-specific immunotolerance effect (immunosuppression) in the peripheral immune cells of subjects with multiple sclerosis.

To date, the use of nanocarriers/drugs produced from myelin are not yet present in the medical landscape. Myelinated nanovesicles could be administered into the body and, through different approaches, counteract neuro-inflammatory diseases.

2. Nutraceutical application

In recent years the advent of nutraceuticals has revolutionized the treatment of CNS pathologies. Nutraceuticals treatment, in fact, has numerous advantages compared to synthetic drugs. The reduced dose of the active ingredient, the absence of adverse reactions and the multiple biological function make the natural molecules excellent adjuvants of pathologies.

The inflammation of the CNS and the alteration/destruction of the myelin sheath that covers the neurons are the main causes of neurodegeneration in most brain diseases, such as Alzheimer's, Parkinson's and Multiple Sclerosis which represent the major cause of neurological disorders that afflict the world population.

Therefore, developing nutraceuticals capable of having multilevel action represents one of the major challenges for the treatment of neurodegeneration in brain pathologies. Myelin nanovesicles, acting both as anti-inflammatories and as myelin restorative, could support classical therapies for the treatment of CNS disorders. The simplicity of formulation of these nano-vesicles makes them suitable for oral suspension as they are easily dispersed in aqueous solutions.

The basic concept is to integrate myelin where there is a pathology with loss or alteration of the myelin itself and modulate the inflammatory process.

A supplement made of the same material subject to alteration and destruction in a pathology would have a significant impact on the buyer affected by the pathology and a significant impact on the market.

Type of innovation: Product innovation

Description of innovative features / Competitive advantages

MyVes could represent a valuable innovative tool for an effective therapy against neuroinflammatory diseases and neuropathies with particular attention to multiple sclerosis. MyVes have the following advantages:

- Ease of procurement, large quantities and reduced costs of the raw material (brain tissue)
- Simple, highly reproducible and scalable production protocols
- Production waste reduced or completely absent (minimal economic and environmental impact)
- Production using GMP protocols
- Standardizable production batches
- The nanovesicles are stable in solution and can also be freeze-dried, which allows for long storage periods and long transport times (the production plant may be far from the place of use).
- Non-invasive administration: nasally and/or orally
- Attractive commercial advantage towards the buyer who purchases a potential drug/supplement made up of the same component (myelin) which is destroyed in the demyelinating pathology he suffers from

Reference market: Total innovation

Development stage: Prototype

TRL: 5, 6

Advantages: New product/process/service/technology

Patentable technology: Yes

Patented technology: Yes

Country/ies: Europe; US; Japan

Publication of technology: Published

Technology validation/demonstration: Internal validation

Market positioning: Italian, European, International

Partner required: Enterprise, Public research center/university, Private research center, Cooperation in national /european / international project

Key words: Brain-derived nano-vesicles, Drug brain delivery, In ammatory brain disorders, Nutraceuticals

Url: *https://promott.cnr.it/en/technology/71/myelin-nano-vesicles-for-the-treatment-ofneuropathies-and-neuro-in ammatory*

IMAGING DEVICE BASED ON SILICON PHOTOMULTIPLIERS (SIPMS) FOR FUNCTIONAL NEAR-INFRARED SPECTROSCOPY (NIRS) OF THE HUMAN BRAIN CORTEX

 # Record card: 72

Thematic areas

ICT & Electronics / Sensor/multi-sensor technology, instrumentation
Health & Biotech / Medical imaging & equipment
Health & Biotech / Diagnostic, Medical imaging & advanced bioimaging
Health & Biotech / Medical Device

Description

NIRS is a non-invasive technique for the human brain cortex imaging based on the measurement of the NIR light emitted by suitable optical sources placed on the patient head and back diffused to the surface after passing through the brain tissues. NIRS monitors the percentage of oxygenated and reduced hemoglobin in the blood, and it allows the real time functional imaging of the brain cortex also in tomographic mode (Diffuse Optical Tomography - DOT). The functional NIRS / DOT requires highly sensitive and fast photodetectors, and it can therefore be dramatically improved by using SiPMs, given their high optical responsivity, millions of times larger compared to that of conventional photodiodes. However, SiPMs present the problem of a reduced linearity range. We propose a new technique to overtake such issue and to allow the efficient implementation of SiPMs for the realization of high performance fNIRS / DOT systems.

Type of innovation: Product innovation

Description of innovative features / Competitive advantages

Current fNIRS / DOT systems are based on either conventional photomultiplier tubes (PMTs), or silicon photodiodes, or avalanche photodetectors. PMTs require optical fibers for the signal transport from the patient head to the detector, with noticeable problems of optical coupling and due to the bulky instrument size. For the fNIRS / DOT systems with silicon photodiodes or avalanche detectors, the instrument size issues are solved, but such photodetectors present responsivities numerous orders of magnitude lower compared to SiPMs. Therefore, the trade-off of sensitivity, size, and channel number of the current NIRS / DOT is much worse than what may be achievable by using SiPMs. The technology here proposed allows the optimal use of SiPMs in fNIRS / DOT, by exploiting at the best the SiPM linear region. Such approach opens the possibility of realizing multichannel systems with high spatial and temporal resolution, with sensitivities much higher compared to the state of the art.

Reference market: Incremental innovation, Impacts on existing markets

Development stage: Feasibility

TRL: 4

Advantages: Product/process/service/technology optimization

Patented technology: Yes

Country/ies: Italy, PCT

Market positioning: Italian, European, International

Partner required: Enterprise, Private research center

Key words: Silicon photomultipliers, Diffuse Optical Tomography, Functional Near Infrared Spectroscopy, Continuous wave

Url: *https://promott.cnr.it/en/technology/72/imaging-device-based-on-silicon-photomultipliersssipms-for-functional-near-infrared*

GEOPOLYMER-BASED ADSORBENTS FOR THE SEPARATION AND REMOVAL OF POLLUTANTS IN GASEOUS PHASE

 # Record card: 73

Thematic areas

Chemicals & Physics / Inorganic substances
Materials / Ceramic materials
Materials / Composite and hybrid materials
Chemicals & Physics / Sustainable substances and green chemistry
Energy and environmental sustainability / Pollution treatment (air, soil, water)

Description

Geopolymers are synthetic inorganic polymers obtained from an aluminosilicate powder and an aqueous solution of alkaline hydroxides or silicates. The material is mesoporous and a multidimensional and functional porosity can be generated through the addition of fillers or the use of specific techniques.
The mix-design of the mixture, pure or composite, allows to change the chemical-physical properties of the final material, also thanks to the nucleation of zeolitic phases. Geopolymers also possess ion exchange and electrostatic interaction capabilities.
By virtue of these characteristics, ISTEC has developed geopolymer matrices and composites containing zeolites, for the adsorption of CO_2. Because of the high selectivity coupled with a good absorption capacity, these materials are suitable for the separation and removal of pollutants in gaseous phase.

Type of innovation: Product innovation, Process innovation

Description of innovative features / Competitive advantages

The water-based reaction, the low consolidation temperature (<100 ° C), the use of low-cost and possibly waste raw materials, make the material both economically and environmentally sustainable.
The possibility to change the stoichiometry and composition, even with the addition of functional fillers, makes these materials extremely versatile. Another industrially advantageous aspect is the possibility to modulate the porosity and give complex shapes to the material. Post-combustion capture of CO_2 represents a feasible measure for reducing the greenhouse effect from fossil fuels in stationary installations, since it can be accomplished downstream without substantial change to the existing processes and facilities. Physical adsorption with solid sorbents is economically competitive with respect to other well-established chemical adsorption technologies.
Biogas purification is another possible application.

Reference market: Incremental innovation, Impacts on existing markets

Development stage: Prototype

TRL: 4

Advantages: New product/process/service/technology, Product/process/service/technology optimization, Cost reduction

Patentable technology: Yes

Patented technology: No

Publication of technology: Published

Technology validation/demonstration: Internal validation

Market positioning: Italian, European, International

Partner required: Enterprise, Cooperation in national /european / international project

Key words: Composites, Geopolymers, Adsorption, Gas separation, Pollutants removal

Url: *https://promott.cnr.it/en/technology/73/geopolymer-based-adsorbents-for-the-separation-andremoval-of-pollutants-in-gaseous*

MODIFICATION OF BIOMACROMOLECULES FROM AGRI-FOOD WASTES FOR FUNCTIONAL APPLICATIONS

 # Record card: 74

Thematic areas

Materials / Properties of materials, corrosion, degradation
Additive and advanced industrial manufacturing / Packaging
Energy and environmental sustainability / Renewable sources
Chemicals & Physics / Plastics & rubber
Chemicals & Physics / Sustainable substances and green chemistry
Energy and environmental sustainability / Waste management
Bioeconomy

Description

The object of the technology is the development of a transferable methodology from the laboratory scale to the pilot scale to be validated in the industrial setting for the treatment of basic waste of natural polymers of agri-food or manufacturing industry. Physical, chemical or a combination of methods for obtaining natural macromolecules can be used in the preparation of mixtures and / or composites, "green" materials that can represent the secondary raw material to be transformed through typical processing equipment of plastic materials (filming, injection molding, 3D printing). Examples of workable waste are legumes, potato, tomato, hemp, fish scales, mollusc exoskeleton, wool, animal skin, paper. In chemical treatments, the use of solvents with high solvent power that can be easily regenerated and reused and from which the polymer of interest can be recovered with a simplified superstructure compared to that assumed in nature will be preferred. Physical methods include the use of microwaves or ultrasounds, which are able to disaggregate natural structures. Combined methods can be used especially in cases where the natural polymer is sensitive to certain chemical-physical parameters such as pH, temperature.

Type of innovation: Product innovation, Process innovation

Description of innovative features / Competitive advantages

The innovative aspects that characterize this technology must be sought in its capability to move inside a circular economy approach, allowing the identification of innovative processes for the treatment of agri-food and manufacturing industry waste characterized by being organic in nature. It is a technology whose development is strongly connected to the detailed knowledge of the chemical nature of the starting material in order to be able to correlate the structure with the properties from the macroscopic scale to the nanometer scale. The technology highlights the versatility of these materials and / or biomolecules to be modified in a controlled and designed manner on the basis of functional and applicative characteristics and properties. The application of chemical and physical treatment methods with reduced environmental impact combined with the molecular knowledge of the starting material allows the planning of the methodological approach by creating a one-to-one relationship between knowing how to design and knowing how to implement.

Reference market: Total innovation

Development stage: Feasibility

TRL: 3, 4

Advantages: New product/process/service/technology, Cost reduction

Patentable technology: Yes

Patented technology: No

Publication of technology: Published

Technology validation/demonstration: Internal validation

Market positioning: Italian, European, International

Partner required: Enterprise, Public research center/university, Private research center, Cooperation in national /european / international project

Key words: Green chemistry, Agri-food wastes, Bioplastics, Physical-chemical properties, Hydrogels

Url: *https://promott.cnr.it/en/technology/74/modi cation-of-biomacromolecules-from-agri-foodwastes-for-functional-applications*

BIOREFINERY PLATFORM FOR RECOVERY OF HIGH VALUE BIOBASED MOLECULES, ENERGY AND BIOFERTILIZER FROM URBAN BIOWASTE

 # Record card: 75

Thematic areas

Energy and environmental sustainability / Environmental engineering/technologies Bioeconomy
Energy and environmental sustainability / Renewable sources - Chemicals & Physics / Organic substances - Energy and environmental sustainability / Energy production, transmission and conversion - Chemicals & Physics / Special chemicals - Chemicals & Physics / Sustainable substances and green chemistry
Energy and environmental sustainability / Waste management

Description

A virtuous multi-step biorefinery platform to convert urban biowaste into valuable molecules, not disregarding renewable energy and digestate production. The strategy is based on the integration of a thermal pretreatment capable of significantly increasing the fraction of fermentable organic carbon, in order to furthermore change the status of the feedstock to become more suitable for production of a) high-value bio-based molecules, b) biomethane and c) hygienized digestate to be recycled as biofertilizer. The liquid fraction, rich of extracted sugars, will be fermented into marketable fatty acids as short-chain-carboxylates having high potential to be biologically upgraded (to caproic acid). The separated solid fraction is transferred to anaerobic digestion. The potential economic value that could be derived is to mitigate the problem of steeply rising land ll costs; to receive revenues from sales of the products, and subsidies for renewable energy. Caproic acid, with a market value of 2000 USD/tonn is an important industrial chemical for several industrial applications including antimicrobial agents.

Type of innovation: Process innovation

Description of innovative features / Competitive advantages

Sustainable waste management is the main area where further improvements are needed to unlock new economic opportunities, improve biomaterials supply to industries, create jobs and consolidate the EU leadership in the green technologies sector. The innovative Platform is designed to be integrated into existing production systems, acting as a biorefinery where organic waste are biologically converted into bio-based chemicals, currently derived from petroleum, producing in parallel biogas and high-quality compost. The economic advantages of these biotechnological processes with respect to the conventional ones are: 1) organic waste is used as feedstock (very little or even negative cost); 2) do not need catalysts as heavy metals; 3) do not need sterilization costs because of the thermal pretreatment; 4) do not use any genetically modified organisms, since work with only naturally occurring organisms. The challenge is to reduce costs and improve sustainability while making it possible to achieve of sufficiently high yields in the targeted product. Compost, black gold for farmers, will restore soil fertility, prevent plant disease and desertification.

Reference market: Impacts on existing markets, Creation of new markets

Development stage: Feasibility

TRL: 4

Advantages: New product/process/service/technology, Cost reduction

Patentable technology: Yes

Patented technology: No

Publication of technology: No

Technology validation/demonstration: Internal validation

Market positioning: Italian, European, International

Partner required: Enterprise, Cooperation in national /european / international project

Key words: Biorenery, Renewable energy, Urban biowaste, Bio-based products, Biofertilizer

Url: *https://promott.cnr.it/en/technology/75/biore nery-platform-for-recovery-of-high-valuebiobased-molecules-energy-and*

PLATFORM FOR DATA ACQUISITION AND EXCHANGE FOR WEARABLE ELECTRONICS

 # Record card: 76

Thematic areas

Health & Biotech / Smart Devices for Health and Wellness
ICT & Electronics / Internet of Things
ICT & Electronics / Electronics and microelectronics
ICT & Electronics / Information processing, information system, workflow management

Description

The platform allows acquisition of data from commercial and custom sensors. By now, the system has been embedded in a wearable wristband where elastomeric based strain gauge have been integrated to detect ne hand/wrist/arm movements. The platform integrates inertial sensors (accelerometers, gyroscopes) to acquire more details about the subject movements. A sensor fusion algorithm enables advanced movement recognition (gesture, 3D orientation). A machine learning algorithm is in development to increase the performance of the platform. This system can be used in different environments such as health assistance, fitness and home entertainment. An ad-hoc software has been developed for data exchange and management.

Type of innovation: Product / process innovation in integration with an already existing technology

Description of innovative features / Competitive advantages

The system integrates an elastomeric sensor array. Differently from the technologies actually used in this kind of devices (accelerometers/myoelectric sensors), it is able to detect ne and localized deformation of the wrist caused by wrist or finger movements, enabling, with the support of a machine learning algorithm, higher accuracy and gesture numbers recognition.

Reference market: Incremental innovation, Impacts on existing markets, Creation of new markets

Development stage: Prototype

TRL: 3, 4

Advantages: Product/process/service/technology optimization

Patentable technology: Yes

Patented technology: No

Market positioning: Italian, European, International

Partner required: Public research center/university, Cooperation in national /european / international project

Key words: Data aquisition system, Bluetooth LE, Thermo plastic elastomer, Strain gauge

Url: *https://promott.cnr.it/en/technology/76/platform-for-data-acquisition-and-exchange-forwearable-electronics*

PLATFORM FOR DATA ACQUISITION AND EXCHANGE FOR PRECISION AGRICULTURE AND ENVIRONMENT MONITORING

 # Record card: 77

Thematic areas

ICT & Electronics / Sensor/multi-sensor technology, instrumentation
Agrifood / Agriculture
Agrifood / Forestry
ICT & Electronics / Electronics and microelectronics
ICT & Electronics / Internet of Things
ICT & Electronics / Information processing, information system, workflow management

Description

The platform allows the deployment of a sensor network with peripheral nodes spread on the crop fields or on the environment for the monitoring of crop parameters/environmental parameters. The network architecture integrated LoRa peripheral nodes for short-medium range communication and star-center NB-IoT based for long range communication. It includes a web server and MySQL database for data storage and visualization. The network architecture is scalable to adapt to the area to monitor. The sensor nodes have been developed to be low maintenance thanks to energy harvesting system embedded on them. The platform has born to support the development of the flexible sensors fabricated in our research institute. In particular, by now, flexible wet sensor and gas sensor are in development to enable direct integration on plant.

Type of innovation: Product / process innovation in integration with an already existing technology

Description of innovative features / Competitive advantages

In the context of the precision agriculture, the possibility to integrate flexible sensors directly on the crops enables a more detailed an accurate study of the crop parameters. The platform, structured in sensor nodes of few centimeters, represents a flexible architecture that integrates and enhance the localized information of these sensors, with the purpose to obtain an effective added value in terms of information obtained.

Reference market: Creation of new markets

Development stage: Prototype
TRL: 4, 5

Advantages: Cost reduction
Patentable technology: No

Patented technology: No
Technology validation/demonstration: External validation

Market positioning: Italian, European, International
Partner required: Public research center/university, Private research center, Cooperation in national /european / international project

Url: *https://promott.cnr.it/en/technology/77/platform-for-data-acquisition-and-exchange-forprecision-agriculture-and-environment*

INCIPIT¬_ INTEGRATED CONDUCTIVE AND BIOMIMETIC POLYMERIC INTERFACES ABLE TO SERVE AS MICRO-NANOSTRUCTURED PATCHES FOR MYOCARDIAL REGENERATION

 # Record card: 78

Thematic areas

Chemicals & Physics / Micro and nanotechnology related to physical, chemical and exact sciences
Health & Biotech / Medical Device
Health & Biotech / Regenerative Medicine
Materials / Plastics, polymers

Description

INCIPIT technology allowed the implementation of a multifunctional, micro-structured and electroconductive therapeutic product to treat patients with myocardial infarction, the leading cause of death for cardiovascular disease. Current therapies (drugs, bypass, angioplasty) do not restore the functionality of damaged myocardial tissue. INCIPIT technology aim is to stimulate the autonomous regeneration of myocardium and to protect the tissue against ventricular remodeling using advanced nanotechnologies. The *in vivo* approach, on which our technology is based, is the scientific option that poses the most ambitious challenges, but it is also the most attractive option for the market of smart therapies in cardiovascular eld. The absence of an *in vitro* culture phase presents a series of advantages that makes this specific solution extremely attractive and faster to the biomedical industry.

Type of innovation: Process innovation

Description of innovative features / Competitive advantages

The main step of innovation consists in the development of bioartificial, microstructured and electroconductive scaffolds able to induce stem cell commitment to a cardiac phenotype thanks to an optimal synergy among physico-chemical, electromechanical and structural characteristics. The innovation regards also the use of advanced nanotechnologies able to recruit endogenous stem cells and to prevent cardiac dysfunction after myocardial infarction. The cardiac patches currently available on the market offer mechanical support but are not able to provide biologically active and regenerative properties. INCIPIT technology offers a multifunctional approach in terms of mechanical support, regenerative action and reduction of ventricular remodeling.

Reference market: Incremental innovation, Impacts on existing markets

Development stage: Feasibility

TRL: 4

Advantages: Product/process/service/technology optimization

Patentable technology: Yes

Patented technology: No

Market positioning: Italian, European, International

Partner required: Enterprise, Private research center, Cooperation in national /european / international project

Key words: Cardiac patch, Myocardial regeneration, Advanced nanotechnologies, Ventricular remodeling, Electroconductivity

Url: *https://promott.cnr.it/en/technology/78/incipit-integrated-conductive-and-biomimeticpolymeric-interfaces-able-to-serve-as*

ULTRA-THIN AND ULTRA- FLEXIBLE GAS SENSORS

 # Record card: 79

Thematic areas

Materials / Semiconductors and Superconductors
Chemicals & Physics / Micro and nanotechnology related to physical, chemical and exact sciences Agrifood / Agriculture
Health & Biotech / Nanomedicine
Health & Biotech / Medical Device
ICT & Electronics / Nanotechnologies related to electronics and microelectronics
Health & Biotech / Biosensors
Energy and environmental sustainability / Sensory
Chemicals & Physics / Inorganic substances
Chemicals & Physics / Organic substances
ICT & Electronics / Electronics and microelectronics
Materials / Plastics, polymers

Description

Our team can develop low-cost ultra- flexible sensors integrated on plastic substrate for volatile organic compounds (VOCs) and gas detection. These devices combine scalable fabrication technologies, implementing active materials such as nanostructured metal oxides or stack of nanostructures decorated with metal nanoparticles, thus enabling a high sensitivity (in the range of hundreds of ppb). These devices can be applied to numerous industrial and commercial sectors, and they can be embedded in systems that are more sophisticated. These sensors operate at room temperature and can detect pollutants like NO, NO2, CO, CO2, CH4 or alcohols and solvents. These devices can be deployed on smart sensor networks in order to build a distributed and light monitoring infrastructure.

Type of innovation: Product innovation

Description of innovative features / Competitive advantages

The advantages of these sensors are several: 1) Ultra- flexibility for covering non-planar surfaces; 2) Low visual impact (almost transparent); 3) Large range of detection (500 ppb-500 ppm); 4) Low working temperature (25°C); 5) Active materials can be easily tuned to create different sensors (electronic nose approach).

Reference market: Total innovation

Development stage: Prototype

TRL: 5

Advantages: New product/process/service/technology, Cost reduction

Patentable technology: Yes

Patented technology: No

Publication of technology: Published

Technology validation/demonstration: Internal validation

Market positioning: Italian, European, International

Partner required: Enterprise, Public research center/university, Private research center, Seed capital, Cooperation in national /european / international project

Key words: Flexible sensors, Ultra-thin devices, Precise agriculture, Air quality, VOCs

Url: *https://promott.cnr.it/en/technology/79/ultra-thin-and-ultra- exible-gas-sensors*

AUTO FLUORESCENCE LIFETIME IMAGING OPTICAL FIBER-PROBE FOR MINIMALLY INVASIVE CLINICAL DIAGNOSTIC

 # Record card: 80

Thematic areas

Health & Biotech / Smart Devices for Health and Wellness
Health & Biotech / Diagnostic, Medical imaging & advanced bioimaging
Health & Biotech / Medical Device
Health & Biotech / Biosensors
Health & Biotech / Bio-medicals
Health & Biotech / Medical imaging & equipment
Health & Biotech / Diagnostic kits
Health & Biotech / Bioinformatics

Description

Time-correlated single photon counting (TCSPC) is regarded as the “gold-standard” method for fluorescence lifetime measurements. However, TCSPC requires using highly sensitive detectors, not suitable for measurements under bright light conditions, thereby making the use impractical in clinical settings. The invention described here solves this problem by synchronizing the fluorescence detection with an external light source. This method guarantees that fluorescence and background photons are temporally resolved, and the fluorescence signal is free from bright background light, which makes TCSPC measurements possible and practical under bright background conditions. The impact and applicability of this method in clinical procedures is further increased by using a fiber-optic probe for excitation light delivery and fluorescence collection. Fluorescence lifetime maps can be created and displayed from single point fiber-based measurements, to provide clinical feedback in real time.

Type of innovation: Product / process innovation in integration with an already existing technology

Description of innovative features / Competitive advantages

Relative to traditional TCSPC measurements using a single point approach, this invention has the following advantages: (1) measurements can be realized under bright light illumination, which makes TCSPC acquisition possible and practical in clinical procedures; (2) fast data acquisition together with parallel computing permits data processing in real time (50 Hz) using the phasor approach, thereby providing real time feedback of the fluorescence measurements; (3) measurements are spatially resolved by adding a visual reference to be detected and segmented in real time to provide spatial feedback to the operator. Relative to Marcu et al [US 2017/0370843 A1, 2017], this invention has the advantage of using more accurate and reliable data acquisition technology and realizing data acquisition and processing in a single computer, thereby avoiding the potential bottleneck of communications between platforms and its impact on the overall performance.

Reference market: Incremental innovation, Impacts on existing markets

Development stage: Prototype

TRL: 4, 5

Advantages: New product/process/service/technology, Product/process/service/technology optimization, Cost reduction

Patented technology: Yes

Country/ies: Italy, PCT

Publication of technology: Published

Technology validation/demonstration: Internal validation

Market positioning: Italian, European, International

Partner required: Enterprise, Private research center, Seed capital, Cooperation in national /european / international project

Key words: Fluorescence lifetime imaging, Time-correlated single photon counting, Auto uorescence, Tissue diagnostics, Surgical guidance

Url: *https://promott.cnr.it/en/technology/80/auto uorescence-lifetime-imaging-optical- ber-probefor-minimally-invasive-clinical*

ULTRA-THIN AND ULTRA- FLEXIBLE TACTILE/PRESSURE SENSORS

 # Record card: 81

Thematic areas

ICT & Electronics / Smart cities and Communities
Health & Biotech / Smart Devices for Health and Wellness
ICT & Electronics / Robotics and control systems
ICT & Electronics / Internet of Things
Automotive transport and logistics / Vehicles
Health & Biotech / Medical Device
Health & Biotech / Micro and nanotechnology related to biological sciences
Additive and advanced industrial manufacturing / Robotics
ICT & Electronics / Electronics and microelectronics
Materials / Plastics, polymers

Description

IMM has developed tactile sensors for the detection of objects and surface and for the handling of objects with humanoid robots (e-skin). These devices can be integrated on ultra- flexible and high conformable substrates and they can be used for multiple applications: 1) for a correct interaction with objects distributed in complex environment; 2) for a safe short-range interaction between humanoid robot and humans; 3) for fabricating smart wearables for the detection of biometric parameters (e.g. heartbeat); 4) for remotely control rovers with wearable gadgets.

Type of innovation: Product / process innovation in integration with an already existing technology

Description of innovative features / Competitive advantages

The main advantages of this technology are related to: 1) Ultra- flexibility of the sensors; 2) Large range of operation (for forces of few N to few KN); 3) the devices can be embedded in smart garments or in armband; 4) Device thickness (extremely low, down to 4 um).

Reference market: Incremental innovation, Creation of new markets

Development stage: Prototype

TRL: 4, 5

Advantages: Product/process/service/technology optimization

Patentable technology: Yes

Patented technology: No

Publication of technology: Published

Technology validation/demonstration: Internal validation

Market positioning: Italian, European, International

Partner required: Enterprise, Private research center

Key words: Tactile sensors, Electronic skin, Wearables, Human machine interaction, Piezoelectric sensors

Url: *https://promott.cnr.it/en/technology/81/ultra-thin-and-ultra- exible-tactilepressure-sensors*

ULTRA- FLEXIBLE AND ULTRA-COMPACT BRAIN COMPUTER INTERFACE FOR RECORDING AND BRAIN STIMULATION

 # Record card: 82

Thematic areas

Health & Biotech / Smart Devices for Health and Wellness
Health & Biotech / Medical Device
Health & Biotech / Micro and nanotechnology related to biological sciences
Health & Biotech / Diagnostic kits

Description

We present a new concept of ultra-compact, configurable and implantable brain computer interface (BCI). The device can be applied to monitor or stimulate, with high temporal and spatial accuracy, neural activity of the brain. It allows implementation of closed-loop algorithms in real time applications. The system can be also used in vitro to monitor or induce cell growth or as tDCS tool. The system can be customized (microelectrodes materials and shapes) to guarantee the best solution for the specific application. Thanks to its modular design, the system is intrinsically multi-purpose and it can be easily adapted into a large variety of applications such as Electrocorticography (ECoG), Electromyography (EMG), Electroencephalography (EEG), Electrocardiography (ECG), Transcranial stimulation, etc. The novelty of the system relies on the possibility to exploit nanomaterials and advanced microelectronics to tailor specific tasks in a bidirectional communication with the brain.

Type of innovation: Product innovation, Process innovation

Description of innovative features / Competitive advantages

Ultra-compact electronic system (board with dimensions similar to a 2€ coin)

- Ultra- flexible microelectrode array (down to 4 um whole thickness)
- Low latency in the bidirectional communication (ms)
- Nanostructured electrode surface to increase the signal to noise ratio.

Reference market: Incremental innovation, Impacts on existing markets, Creation of new markets

Development stage: Prototype

TRL: 7

Advantages: New product/process/service/technology

Patented technology: No

Technology validation/demonstration: Internal validation

Market positioning: Italian, European, International

Partner required: Enterprise, Seed capital, Cooperation in national /european / international project

Key words: Brain Computer Interface, Smart microelectrodes arrays, Brain implant, tDCS, Closedloop communication

Url: *https://promott.cnr.it/en/technology/82/ultra- exible-and-ultra-compact-brain-computerinterface-for-recording-and-brain*

APTALAB - APTAMERS DEVELOPMENT SERVICE FOR BIOMEDICAL APPLICATIONS

 # Record card: 83

Thematic areas

Health & Biotech / Micro and nanotechnology related to biological sciences
Health & Biotech / Bio-medicals
Health & Biotech / New therapies
Health & Biotech / Diagnostic kits
Health & Biotech / Smart Devices for Health and Wellness
Health & Biotech / Nanomedicine
Health & Biotech / Diagnostic, Medical imaging & advanced bioimaging
Health & Biotech / Development of new drugs
Health & Biotech / Biosensors

Description

Aptamers, short structured single-stranded oligonucleotides binding at high affinity to a given target protein, are selected from large combinatorial libraries through repeated cycles of incubation of the library with the target, recovery and amplification of target-bound oligonucleotides (SELEX technology, Systematic Evolution of Ligands by EXponential enrichment). SELEX can be applied to select aptamers against a known target protein or against a specific cell phenotype, without any prior knowledge of the specific target, leading to new biomarkers discovery. Our team offers a SELEX technology platform for the easy and efficient isolation of nuclease-resistant RNA aptamers for diagnostic and therapeutic applications. We can meet customer's needs providing aptamers with the desired properties, including: high affinity/specificity; inhibition or activation of the target protein; identification/validation of new biomarkers; cell- and tissue-specific targeting.

Type of innovation: Service/know how innovation

Description of innovative features / Competitive advantages

Aptamers represent a valid alternative to other recognition molecules, as peptides and monoclonal antibodies, in various biomedical applications, thanks to: cost- and time-effective production; high purity and very low inter-batch variability; resistance to harsh environment conditions (pH and temperature); low molecular weight; low toxicity and immunogenicity; easy chemical modifications to further increase their stability, bioavailability and pharmacokinetics and to allow their simple immobilization or labeling for the use in diagnostic assays or for the conjugation to secondary therapeutic agents. Compared to the main players operating in the aptamers' market, our team of experts offers a highly personalized service for the selection of aptamers with the characteristics desired by the customer, guaranteeing an optimized finished product in a time- and cost competitive manner.

Reference market: Impacts on existing markets

Development stage: Industrialization

TRL: 4

Advantages: Product/process/service/technology optimization, Cost reduction

Patentable technology: Yes

Patented technology: No

Technology validation/demonstration: External validation

Market positioning: Italian, European, International

Partner required: Enterprise, Public research center/university

Key words: SELEX, Aptamers, Diagnostic agents, New therapeutics

Url: *https://promott.cnr.it/en/technology/83/aptalab-aptamers-development-service-forbiomedical-applications*

DragONE

 # Record card: 84

Thematic areas

Health & Biotech / Bio-medicals

Health & Biotech / Smart Devices for Health and Wellness

Description

This technology is an e-health application. The DragONE application is inspired by the global guidelines for the management of asthma, which promote the opportunity to implement a multidimensional assessment of pediatric asthma using innovative systems. DragONE allows to record data on the subjective control of asthma, by using easy-to-understand colors and icons for children (red, yellow or green dragon), to keep track to the patient's of perceived state.

Type of innovation: Product innovation, Product / process innovation in integration with an already existing technology, Service/know how innovation

Description of innovative features / Competitive advantages

The innovative features of the app are:

- User interface developed to ensure a user experience suited to the pediatric target- Bluetooth for connection to devices for the evaluation of respiratory function.
- Alerting system that allows the parent / child to be reminded to carry out periodic tests and monitoring, thus improving adherence to the treatment plan
- Use of the calendar of events / appointments of the mobile device by inserting the events of the care plan

The main advantage consists in the uniqueness of the application given that are no other commercial tools capable of providing an overall picture of the treatment path and the state of perceived well-being.

Reference market: Incremental innovation

Development stage: Prototype

TRL: 7

Advantages: New product/process/service/technology, Product/process/service/technology optimization

Patentable technology: Yes

Patented technology: No

Publication of technology: No

Technology validation/demonstration: External validation

Market positioning: Italian, European, International

Partner required: Enterprise, Cooperation in national /european / international project

Key words: e-health, Asthma, Wellbeing, Children

Url: htt*ps://promott.cnr.it/en/technology/84/dragone*

SPIROMETRIX

 # Record card: 85

Thematic areas

Health & Biotech / Smart Devices for Health and Wellness
Health & Biotech / Diagnostic, Medical imaging & advanced bioimaging
ICT & Electronics / IT and Telematics applications
Health & Biotech / Medical Device

Description

This technology is based on an algorithm able to provide the probability of being asthmatic with high accuracy. This probability is based on the evaluation of respiratory function and, specifically, of forced expiratory vital capacity in the first second (FEV1), in resting conditions, and 20 minutes after administration of a bronchodilator drug. The algorithm uses 2 FEV1 threshold values together with some information on the subject (gender, season at the visit, allergic sensitization to inhalant allergens - mold, pollen, pet epithelia, dust mite), to give an estimate of the probability of asthma. The result provides an immediate benefit for the clinical management of the patient constituting a step forward for good clinical practice.

Type of innovation: Product / process innovation in integration with an already existing technology

Description of innovative features / Competitive advantages

The framework based on the new bronchoreversibility cut-offs creates 3 categories of risk: low (<7.9%), intermediate (7.9% -14.7%) and high (≥14.7%). By also accounting for the subject information, the proposed approach provides very good diagnostic accuracy in discriminating asthmatic and non-asthmatic subjects, outperforming the current rule-of thumb based on the 12% cut-off. For example, subjects with FEV1 <12% who would be, as of now, too rigidly classified as non-asthmatics could be classified differently, and perhaps more correctly, depending on other explanatory prognostic factors. Ultimately, our algorithm would provide the competitive advantage of having better performance in terms of diagnostic accuracy for first level screening.

Reference market: Incremental innovation

Development stage: Feasibility

TRL: 4

Advantages: Product/process/service/technology optimization

Patentable technology: Yes

Patented technology: No

Publication of technology: No

Technology validation/demonstration: Internal validation

Market positioning: Italian, European, International

Partner required: Enterprise, Cooperation in national /european / international project

Key words: Asthma, Bronchodilator response, Diagnosis, Dynamic nomogram, Children

Url: *https://promott.cnr.it/en/technology/85/spirometrix*

HIGH COMPLEX ANTHOCYANIN PRODUCING PLATFORM IN POTATO CELL CULTURE

 # Record card: 86

Thematic areas

Agrifood / Nutrition & health
Agrifood / Food quality & safety
Health & Biotech / Care, Hygiene, Cosmetics

Description

Anthocyanins are antioxidant polyphenolic pigments produced by plants that are widely used in the food, cosmetic and pharmaceutical industries. The technology allows to obtain in a short time potato cell lines in which the production of highly acetylated and highly complex anthocyanins is increased in addition to other antioxidant polyphenolic compounds. The obtained cellular lines have a high production efficiency, comparable to the extraction of berries, but with the advantage of having an on-demand production which is not limited to seasonality. Furthermore, our technology nearly doubles the anthocyanin production, becoming an advantage over other similar biological platforms. The extraction of antioxidant compounds can be achieved through green extraction technology, ie without the use of toxic solvents.

Type of innovation: Service/know how innovation

Description of innovative features / Competitive advantages

Compared to similar production technologies, i.e. in cell culture, our technology allows to increase the total anthocyanin content by more than double. In particular, the technology works perfectly on plant lines where highly complex, stable and diversified anthocyanins are produced with a high capacity to resist different variations in pH and temperature. With the same production costs, with our technology it is possible to double the production efficiency.

Reference market: Total innovation, Impacts on existing markets

Development stage: Prototype

TRL: 4

Advantages: Product/process/service/technology optimization, Cost reduction

Patentable technology: Yes

Patented technology: No

Technology validation/demonstration: Internal validation

Market positioning: Italian, European, International

Partner required: Seed capital, Cooperation in national /european / international project

Key words: Anthocyanins, Plant cell colture, Green production, Antioxidants

Url: *https://promott.cnr.it/en/technology/86/high-complex-anthocyanin-producing-platform-inpotato-cell-culture*

SITODIET

 # Record card: 87

Thematic areas

ICT & Electronics / Big Data
Agrifood / Nutrition & health
Health & Biotech / Smart Devices for Health and Wellness
ICT & Electronics / Artificial Intelligence
ICT & Electronics / IT and Telematics applications

Description

SITODIET is an innovative software that supports a translational approach to health's state. It integrates various sources of physiological, behavioral, and psychological data to reduce the risks associated with the onset of lifestyle-related diseases (primary prevention), to support health professionals in early diagnosis (secondary prevention) or to manage the personalized therapy's patient (tertiary prevention). SITODIET collects data automatically, through actigraphy tools, as wristband or smartwatch, or manually through users' input related to his/her lifestyle, results of clinical records or the monitoring of psychological aspects such as the mood or anxiety levels. SITODIET could be manage via several devices (smartphone, tablet, PCs) and it will be subject to continuous scientific updating.

Type of innovation: Service/know how innovation

Description of innovative features / Competitive advantages

The innovative aspect of SITODIET is the integration of the user's personal data and clinical, biochemical and sensors parameters for the promotion of well-being and a better quality of life through a multidisciplinary approach, based on prevention and the adoption of correct lifestyles. The intervention on controllable lifestyle factors, such as nutrition, physical activity, and stress reduction, is actually the basis of the prevention of chronic non-communicable and communicable diseases and their early and symptomatic treatment. Unlike other solutions on the market, SITODIET integrates physiological, behavioural, and psychological parameters and analyses them using artificial intelligence algorithms, suggesting changes in the user's lifestyle and promptly intercepting any risk factors. SITODIET will be in Italian language in phase1, in phase2 in English, German, Spanish and French for international market.

Reference market: Incremental innovation

Development stage: Idea

TRL: 2

Advantages: Product/process/service/technology optimization

Patentable technology: Yes

Patented technology: No

Technology validation/demonstration: Internal validation

Market positioning: Italian

Partner required: Enterprise, Public research center/university, Private research center, Seed capital, Cooperation in national /european / international project

Key words: Prevention, Health, Nutrition, Physical activity, Wellbeing

Url: *https://promott.cnr.it/en/technology/87/sitodiet*

SixAPT - MULTIPLEX APTAHISTOCHEMISTRY KIT FOR THE IDENTIFICATION AND CHARACTERIZATION OF TRIPLE-NEGATIVE BREAST CANCER (TNBC)

 # Record card: 88

Thematic areas

Health & Biotech / Diagnostic kits

Description

TNBC affects around 170,000 patients worldwide each year and accounts for 15-20% of breast cancer; compared to other types of breast cancer, TNBC is more aggressive and precocious. Its diagnosis, made difficult by the existence of subtypes with different characteristics, is fundamental to establish prognosis and personalized therapy. Nucleic acid aptamers are highly selective low molecular-weight molecules, synthesizable at low cost and easily modifiable, capable of binding and detecting tissue markers ("aptahistochemistry"). Our team has identified 6 RNA aptamers which specifically recognize 6 different TNBC markers, distinguishing subtypes with different aggressiveness. Our idea foresees the development of a kit for the identification and characterization of TNBC, based on a simple protocol in which the 6 aptamers are incubated simultaneously on the same sample (multiplex).

Type of innovation: Product innovation

Description of innovative features / Competitive advantages

TNBC is diagnosed by immunohistochemistry, with antibodies against 3 proteins, in separate reactions, on different slices of tissue. Our kit provides the simultaneous use ("multiplex") of 6 aptamers, suitably modified, which, being synthesized chemically, are cheaper, more stable and reliable in terms of reproducibility compared to antibodies. Our kit allows the detection, on the same sample, of as many as 6 markers, with a considerable reduction of the time and improvement of the information on the state of progression of the tumor; it also allows, for the first time, the sub-typing of the TNBC, a basic diagnostic data on which to identify the most appropriate therapeutic strategy. There are no competitors that produce TNBC kits based on multiplex aptahistochemistry.

Reference market: Total innovation

Development stage: Feasibility

TRL: 4

Advantages: New product/process/service/technology

Patentable technology: Yes

Patented technology: No

Publication of technology: No

Market positioning: Italian, European, International

Partner required: Enterprise

Key words: Aptamers, Triple-negative breast cancer, Aptahistochemistry, Kit, Pathological anatomy

Url: *https://promott.cnr.it/en/technology/88/sixapt-multiplex-aptahistochemistry-kit-for-theidentifation-and-characterization*

CHEMICAL-PHYSICAL INTERFACE DESIGN AS A TOOL FOR SUCCESSFUL FABRICATION OF ADVANCED MATERIALS: ALLOYS AND COMPOSITES MATERIALS

 # Record card: 89

Thematic areas

Aerospace and Earth Science / Space sciences - Aerospace and Earth Science / Aeronautical technologies and avionics - Aerospace and Earth Science / Satellite technologies - Automotive transport and logistics / Vehicles - Automotive transport and logistics / Shipbuilding - Automotive transport and logistics / Propulsion Automotive transport and logistics / Transport infrastructures - Additive and advanced industrial manufacturing / Additive manufacturing processes and materials - Additive and advanced industrial manufacturing / Vacuum/High vacuum technologies - Chemicals & Physics / Inorganic substances - Chemicals & Physics / Man made fibres - Chemicals & Physics / Special chemicals - Chemicals & Physics / Sustainable substances and green chemistry - Materials / Building materials - Materials / Ceramic materials - Materials / Composite and hybrid materials - Materials / Metals & alloys - Materials / Properties of materials, corrosion, degradation - Materials / Semiconductors and Superconductors - Energy and environmental sustainability / Renewable sources - Energy and environmental sustainability / Rational use of energy - Energy and environmental sustainability / Nuclear fission/nuclear fusion - Energy and environmental sustainability / Cleaner use of fossil fuels - Energy and environmental sustainability / Nuclear engineering - Energy and environmental sustainability / Safety and security - Energy and environmental sustainability / Environmental engineering/technologies - Energy and environmental sustainability / Building materials Health & Biotech / Bio-medicals

Description

Nowadays, to properly design and develop advanced materials capable to preserve for long times their performance under aggressive environments such as power generation plants, renewables, nuclear reactors and electronics of new generation, transport on ground and on space, aeronautics, catalysis, biomedical implants, the optimization of metallurgical processes involved is crucial. To this end, in order to obtain the requested thermo-mechanical properties related to the final microstructure, the appropriate operating process parameters can be deduced from preliminary studies on thermodynamic and thermophysical properties, wetting, interaction and reactivity at the interfaces. Specifically, the present approach allows to optimize fabrication roots for new concept alloys such as Superalloys, HEAs, BMGs, etc.; Solder and Brazing alloys for 2D and 3D materials; Alloys for AM; Structural materials and composites for metal cooled plants; Lightweight and advanced composites for extreme conditions such as MMCs and CMCs as well as optimization of infiltration process and joining techniques; Metal NPs.

Type of innovation: Product / process innovation in integration with an already existing technology

Description of innovative features / Competitive advantages

The combined approach between theoretical and experimental methods allows, working in a synergy, to improve both the methods applied. Specifically, the experimental work-plan, supported by the theoretical activity, may be targeted and vice versa, by taking into account the experimental observations, the theoretical description may be better addressed to scenarios much more close to the reality. By such improved combined approach, the full description of the overall evolving phenomena can be successfully obtained. In addition, such know-how can be scaled-up and all the gained knowledge can be easily transferred from the laboratory to the industry. The innovation is given by the combined scientific method applied, that can be easily set-up and “shaped” according to the current needs, which is typical for optimization processes.

Reference market: Incremental innovation, Impacts on existing markets

Development stage: Feasibility

TRL: 4, 5

Advantages: Product/process/service/technology optimization

Patentable technology: Yes

Patented technology: No

Technology validation/demonstration: Internal validation

Market positioning: Italian, European, International

Partner required: Enterprise, Public research center/university, Cooperation in national /european / international project

Key words: Metal systems at high temperatures, Metal-metal and metal-ceramic interfaces, Composites, Modelling, In ltration, Thermophysical properties

Url: *https://promott.cnr.it/en/technology/89/chemical-physical-interface-design-as-a-tool-forsuccessful-fabrication-of-advanced*

DOPING OF SEMICONDUCTORS FROM CHEMICAL SOLUTIONS

 # Record card: 92

Thematic areas

Chemicals & Physics / Micro and nanotechnology related to physical, chemical and exact sciences Materials / Semiconductors and Superconductors - Additive and advanced industrial manufacturing / Additive manufacturing processes and materials ICT & Electronics / Nanotechnologies related to electronics and microelectronics

Description

Molecular doping (MD) is a doping method based on the use of liquid solutions. The dopant precursor is in liquid form and the material to be doped is immersed in the solution. During the immersion process, the molecule containing the dopant atom is deposited on the surface of the material forming a self-assembled monolayer, that is, ordered and compact. Through a subsequent heat treatment, the molecule decomposes and the dopant diffuses.

Type of innovation: Process innovation, Product / process innovation in integration with an already existing technology

Description of innovative features / Competitive advantages

Since the precursor is in liquid form, MD intrinsically allows conformal doping, even in porous or hollow structures. Furthermore, the density and the positions of the dopant atoms on the Si surface are fixed by the self-assembly mechanism, allowing to eliminate all the problems related to the statistical arrival at the nanometric scale of the dopant atoms on the Si surface, as occurs in traditional ion implantation. A further advantage consists in the fact that the method uses low cost and low environmental impact materials and processes.

Reference market: Incremental innovation, Impacts on existing markets

Development stage: Prototype

TRL: 4

Advantages: Product/process/service/technology optimization, Cost reduction

Patentable technology: No

Patented technology: Yes

Country/ies: Italy, PCT

Publication of technology: Published

Technology validation/demonstration: Internal validation

Market positioning: Italian, European, International

Partner required: Enterprise, Cooperation in national /european / international project

Key words: Semiconductors, Doping, Molecules

Url: *https://promott.cnr.it/en/technology/92/doping-of-semiconductors-from-chemical-solutions*

VES4YOU, A NOVEL BIO-NANOTECHNOLOGY: EXTRACELLULAR VESICLES FROM A NATURAL SOURCE

 # Record card: 93

Thematic areas

Health & Biotech / Micro and nanotechnology related to biological sciences
Materials / Processes of production & treatment of materials
Chemicals & Physics / Micro and nanotechnology related to physical, chemical and exact sciences Agrifood / Marine resources Agrifood / Nutrition & health
Health & Biotech / Nanomedicine
Health & Biotech / Development of new drugs
Chemicals & Physics / Sustainable substances and green chemistry
Health & Biotech / Regenerative Medicine

Description

Safe, efficient and specific nano-delivery systems are increasingly needed for precision and regenerative medicine and targeted therapies (e.g. anticancer and antimicrobial therapies), as well as for the cosmetic and nutraceutical sectors' applications. Despite the appreciable success of synthetic nanovectors, like for example liposomes, their clinical and market application is hampered by some limitations: • large scale production, • low-cost production • intrinsic toxicity • limited cellular uptake • limited consumer acceptance. Delivery systems based on extracellular vesicles (EVs) can overcome these limitations. Cells communicate with each other and respond to a variety of stimuli by secreting extracellular vesicles, which are complex structures of nanometric dimensions, bounded by a biomembrane and containing bioactive molecules. EVs have recently been described as important cellular products to mediate different physiological processes or influence various pathological conditions. EVs are also means of communication between different species and have been identified in all living organisms. In addition to mammalian cells, there are some other bioresources studied for making EVs, including bacteria, cow's milk and plants; some of these have been studied for therapeutic or healthcare applications. The exploitation of the biotechnological potential of EVs as vectors of bioactive compounds for different applications is of growing interest. The growth in this eld is demonstrated by the surge in recent years in the number of publications, patents and clinical studies related to EVs. A disadvantage limiting progress in the current research and exploitation of EVs is the typically low yield obtainable from current systems for downstream applications including clinical trials. This makes EVs-based therapeutics still some distance away. This hurdle can be overcome by using a new natural source proposed here which would allow a scalable and continuous production of EVs with increased yield, purity and reproducibility and by responding to the requirements of new circular economy strategy. In the context of our national and extended PCT patents (December 2020) and the H2020-FETOpen VES4US project (www.ves4us.eu), we propose a renewable natural source for the production of EVs with applications for the nanomedicine, cosmetic or nutraceutical sectors. The proposed extracellular vesicles of natural origin have better stability, controlled release and additional multifunctionality compared to synthetic nanotechnologies. This offers formulation advantages in terms of dose / cost, stability and efficiency. A first aspect of the invention is the novel product, i.e. extracellular vesicles (EVs), obtainable from a natural source. The proposed EVs are made available through the combination of novel and state-of-the-art technologies to isolate EVs based on their intrinsic physical properties. A third aspect of the invention is the use of the natural resource-derived EVs as biogenic nanocarriers for the molecular delivery of bioactive molecules.

Type of innovation: Product innovation, Process innovation, Product / process innovation in integration with an already existing technology, Service/know how innovation

Description of innovative features / Competitive advantages

The selected natural source is renewable and economically sustainable resource of EVs. From our preliminary analyses, it was possible to extrapolate that the proposed natural source has the potential to produce 100 times more EVs, reducing the cost by 10 times and the production Q&C by 5 times. Our analyses show also the presence of important spaces in the market. The global market for extracellular vesicles (exosomes, for example) in 2016 was about 3 million dollars, but the forecast is that this market will increase by 1000 times by 2030. In addition, about 20 companies have invested in as many clinical trials that will begin in 2021 (eg,

https://capricor.com). The proposed innovation based on EVs may have impacts in bio-nanotechnology applications, including: Market 1: research on EVs and general research on life sciences - Market size: has a current value of € 40 million and is expected to 400 million euros by 2022, with a CAGR of 37.8%. Market 2: Customer care (cosmetics) - Market size: the market value is expected to be approximately US $ 758.4 billion by 2025. Market 3: Therapeutic delivery agents - Market size: the market is expected to global drug delivery will reach $ 1,694.7 billion by 2023, with a CAGR of 6.4%. The introduction on the market of these new EVs extracted from the sustainable natural source selected by us has the following advantages: • The EVs are produced from a low cost natural resources • The natural source of EVs is one or more photosynthetic organisms that have a high growth rate, and are renewable • They can be grown in controlled environmental conditions on a large scale • Green and sustainable origin •The EVs are produced by a high yield • the EVs have greater perception and societal acceptance than human or animal cell-derived EVs because they are free of animal origin products and more acceptable from the ethical point of view.

Reference market: Incremental innovation, Impacts on existing markets, Creation of new markets

Development stage: Feasibility

TRL: 5, 6

Advantages: New product/process/service/technology, Product/process/service/technology optimization, Cost reduction

Patentable technology: Yes

Patented technology: Yes

Country/ies: Italy, PCT

Publication of technology: Published

Technology validation/demonstration: Internal validation

Market positioning: Italian, European, International

Partner required: Enterprise, Public research center/university, Private research center, Seed capital, Cooperation in national /european / international project

Key words: Extracellular Vesicles, Bio-nanotechnology, Nano delivery system, Renewable bioresource, Nutraceutics, Cosmetics

Url*: https://promott.cnr.it/en/technology/93/ves4you-a-novel-bio-nanotechnology-extracellularvesicles-from-a-natural-source*

OPTOMECHANICAL METASURFACE MODULATOR

 # Record card: 94

Thematic areas

Chemicals & Physics / Imaging & image processing
ICT & Electronics / Laser technologies
ICT & Electronics / Optics & Acoustic
Chemicals & Physics / Micro and nanotechnology related to physical, chemical and exact sciences
Energy and environmental sustainability / Sensory
ICT & Electronics / Optoacustic sensors, Optoelectronic devices
Chemicals & Physics / Quantum optics
Materials / Optical materials
Chemicals & Physics / Atomic and molecular spectroscopy
ICT & Electronics / Telecommunications

Description

The meta surface optomechanical modulator is a device designed to modulate the amplitude, phase and polarization of a beam of electromagnetic radiation, independently, or simultaneously, according to prescribed paths in the parameter space (for example, as regards polarization, paths on the Poincaré sphere). The concept of our device can be applied to the entire spectrum of electromagnetic waves: from radio frequency to microwaves (GHz), to millimeter waves (THz), to far and near infrared radiation, and to visible light. The device has as its main element a meta surface, which consists of a set of elements, dielectric or metallic, with dimensions smaller than the wavelength of the radiation that they must handle, arranged on a plane (typically, a dielectric surface or a membrane). From the radiation point of view, the metasurface acts as an anomalous interface, so the ordinary Fresnel relations for amplitude and phase of the reflected / transmitted radiation are replaced by values that can be defined ad hoc during the device design phase.

Type of innovation: Product innovation

Description of innovative features / Competitive advantages

Our technology leverages on the concept of metasurface. A metasurface is an "engineered surface" capable of responding to very specific requirements of optical/photonic design (reflection coefficient, birefringence, achromaticity...). In other words, metasurfaces are components whose functionality is established "by design" and not "by material". For example, it is possible to produce variable delay plates without using liquid crystals (thus avoiding the need for a confinement cell), or polarizers without resorting to rare solids in their monocrystalline form (for example, calcite). Typical optical metasurfaces are in fact made of silicon by means of large-scale electronic microfabrication technologies. Our modulation technology allows to overcome the typical speed limits of liquid crystal devices (~1MHz compared to ~10 KHz) and to reduce the dimensions typical of electro-optical devices (~0.1 mm vs ~10 mm).

Reference market: Incremental innovation, Impacts on existing markets

Development stage: Prototype

TRL: 2, 3

Advantages: New product/process/service/technology

Patented technology: Yes

Country/ies: Europe, US

Publication of technology: Published

Technology validation/demonstration: Internal validation

Market positioning: Italian, European, International

Partner required: Enterprise, Public research center/university, Private research center, Seed capital, Cooperation in national /european / international project

Key words: Modulator, Polarization, Ellipsometry, Phased array, Frequency selective surface

Url: *https://promott.cnr.it/en/technology/94/optomechanical-metasurface-modulator*

DEVELOPMENT OF SENSORS BASED ON SURFACE ACOUSTIC WAVE TECHNOLOGY

 # Record card: 95

Thematic areas

Agrifood / Food quality & safety
Aerospace and Earth Science
Chemicals & Physics / Micro and nanotechnology related to physical, chemical and exact sciences
Energy and environmental sustainability / Sensory
ICT & Electronics / Sensor/multi-sensor technology, instrumentation
ICT & Electronics / Electronics and microelectronics
Health & Biotech / Smart Devices for Health and Wellness
Health & Biotech / Biosensors
Tourism, social sciences and cultural heritage / Safety and security

Description

The proposed technology is based on the micro-fabrication of electrodes in order to generate surface acoustic waves (SAW) with well-defined frequencies, on piezoelectric substrates. The operating principle of a surface acoustic wave sensor is linked to the variation of the characteristics of the acoustic wave that propagates on the device (e.g. wave velocity on the substrate, etc.) caused by the interaction with the environment (e.g. interaction of an analyte on the surface of the device, deformation of the substrate, etc.). This variation produces a change in the frequency of the wave, which can be detected with great accuracy thanks to an electronic oscillator that uses the SAW device as a control element. This technology allows to manufacture very small devices (in the order of a few mm2) and obtain sensors with high sensitivity.

Type of innovation: Service/know how innovation

Description of innovative features / Competitive advantages

The described technology has allowed the development of some prototypes of sensors systems tested in the laboratory with excellent results. In particular, in a first application called “Electronic Nose” a system equipped with SAW sensor arrays capable of detecting small concentrations of volatile substances has been developed. In a first version, polymers were used as sensitive materials for the detection of vapors of different analytes, while in a second version proteins (odorant-binding proteins) were used for the detection of odorant molecules in the air. In a second application has been developed an absolute pressure SAW sensor, capable of measuring pressures in the range of 0-3 bar with excellent resolution. In this application, the surface acoustic wave device exploits the deformation of a piezoelectric membrane exposed to the difference between the external pressure and the internal reference pressure. In both cases, the fabrication costs were very low.

Reference market: Incremental innovation, Impacts on existing markets

Development stage: Feasibility

TRL: 4

Advantages: Product/process/service/technology optimization, Cost reduction

Patented technology: No

Technology validation/demonstration: Internal validation

Market positioning: Italian, European, International

Partner required: Enterprise, Cooperation in national /European / international project

Key words: Surface acoustic wave sensors, Electronic nose, Odorant-binding protein, SAW, Pressure sensor

Url: *https://promott.cnr.it/en/technology/95/development-of-sensors-based-on-surface-acousticwave-technology*

POLISHING PAPER DECORATED WITH METALLIC NANOSTRUCTURED FILMS FOR CULTURAL HERITAGE DIAGNOSTICS

 # Record card: 96

Thematic areas

Tourism, social sciences and cultural heritage / Education & learning
ICT & Electronics / Artificial Intelligence
ICT & Electronics / IT and Telematics applications
ICT & Electronics / Multimedia
Tourism, social sciences and cultural heritage / Socio-economic models
Tourism, social sciences and cultural heritage / Multimedia technologies

Description

The proposed technology deals with the development of active SERS (Surface Enhanced Raman Scattering) substrates ad hoc designed for diagnostics of cultural heritage. The substrates are prepared starting from common commercial 'polishing film' sheets (lapping optical fibers) showing an intrinsic roughness (48- 1000 nm) that favors the SERS effect. A pattern of silver or gold nanoparticles are deposited on these films through Pulsed Laser Deposition (PLD). PLD is a technique of growth of materials in the form of thin films where a high-power pulsed laser is focused on a target (Au/Ag) giving arise to the evaporation of a portion of the material in a controlled Argon atmosphere. The presence of the gas induces the formation of clusters and nanoparticles that are collected on the surface of the substrates positioned in front of the target itself. The morphology of the so formed nanostructures can be tuned changing some key parameters during the deposition phase. The procedure allow us to obtain a non-invasive 'sampler' easy to handle, low cost, of immediate use and able to capture single grain of material to be analyzed.

Type of innovation: Product / process innovation in integration with an already existing technology

Description of innovative features / Competitive advantages

The main limitation working with cultural heritage consists in the difficulty to sampling even if in micro quantities. The technology here presented, based on the SERS technique, allows to overcome this problem, in fact simply swabbing the surface with the substrate it's possible to obtain a sample to analyze it in the laboratory. An innovative aspect is represented by the methodology used for the realization of substrates, PLD, a physical technique and therefore without any chemical residue, compared to traditional methods (e.g. Lee and Meisel). In addition, the intrinsic roughness of the substrates favors the collection of pigment single grains from the surface to be analyzed, the SERS effect is enhanced and the fluorescence phenomen, that often affect the Raman spectra of organic substances, is reduced. The substrates are characterized by high reproducibility, flexibility, portability and low cost. Different functionalization design are under consideration to make SERS substrates more specific and to expand the eld of application.

Reference market: Impacts on existing markets

Development stage: Feasibility

TRL: 3, 4

Advantages: Product/process/service/technology optimization

Patentable technology: Yes

Patented technology: No

Technology validation/demonstration: Internal validation

Market positioning: Italian, European, International

Partner required: Enterprise, Public research center/university, Private research center, Cooperation in national /european / international project

Key words: SERS, Cultural Heritage, PLD, Organic pigments, Nanostructured lm

Url: *https://promott.cnr.it/en/technology/96/polishing-paper-decorated-with-metallicnanostructured- lms-for-cultural-heritage*

IDENTIFICATION OF CATCH GEOGRAPHIC AREA IN ITTYO_SPECIES WITH HIGH COMMERCIAL VALUE THROUGH BOTH MICROBIOTA INVESTIGATION AND "OMICS SCIENCE"

 # Record card: 97

Thematic areas

Agrifood / Nutrition & health

Agrifood / Food quality & safety

Description

Our idea come from the improving of the traceability technique in agro-food fisheries industries through the application of omics technologies in microbiota studies. These latter would be capable of exploiting the huge pool of biological molecules contained in fishery resources (e.g. nucleic acids, proteins, metabolites) and use them as a powerful tool for the identification and reconstruction of fishery history, from the sea to the table. Employing integrative approaches, the aims work is to respond above all to the ever increasing need to identify the geographical area origins of the "seafood" and specially in some high added value fishery products.

Through the application of these new technologies, stakeholders may be offer new tools and techniques (production / processing regulations and labels) to transfer more certainty to consumers about the origin and quality of the product purchased.

Type of innovation: Product innovation, Service/know how innovation

Description of innovative features / Competitive advantages

The technologies are proposed to provide each actor of the sh supply chain (from the fisherman to the retailer), which allows them to protect and enhance the high-quality Mediterranean fish products. Differencing aforementioned products in definite manner by without history products, coming from illegal, unregulated and undeclared shing.

The proposed technology would have repercussions through the entire agri-food chain system benefiting the final consumers too, who would be offered a renewed and safe product. Moreover, it may both defense and protect the fish industry network that is capable to curb the huge "mislabeling" pocket, an increasingly widespread and pervasive phenomenon.

Reference market: Incremental innovation, Impacts on existing markets

Development stage: Idea

TRL: 1, 2

Advantages: New product/process/service/technology

Patented technology: No

Market positioning: Italian, European, International

Partner required: Enterprise, Public research center/university, Private research center, Seed capital, Cooperation in national /European / international project

Key words: Omics technologies, Fishing, Geographical area, Mislabeling

Url: *https://promott.cnr.it/en/technology/97/identi cation-of-catch-geographic-area-inittyospecies-with-high-commercial-value*

ALGAL POLYSACCHARIDES AND BIOMETABOLITES AS POTENTIAL DRUGS AGAINST LEISHMANIASIS DISEASE

 # Record card: 98

Thematic areas

Energy and environmental sustainability / Ecology & Biodiversity
Energy and environmental sustainability / Renewable sources
Bioeconomy
Chemicals & Physics / Organic substances
Health & Biotech / New therapies
Health & Biotech / Development of new drugs

Description

Leishmaniasis is a zoonosis caused by the protozoan of the genus *Leishmania*, which affects both humans and animals through a phlebotomist. After malaria and lymphatic filariasis, leishmaniasis is the third most common disease on a global scale. *Leishmania infantum* is the species spread in the European continent and the Mediterranean basin. In Italy, from the hilly coastal areas and major islands, the infection has spread to many pre-Alpine areas and northern Italy. Our research is evaluating the effectivenes of the activity of polysaccharides and biometabolites extracted from marine macroalgae against *L. infantum*. The polysaccharides were extracted from two brown algae from the Venice Lagoon, *Sargassum muticum* and *Undaria pinnati da*; the biometabolites were extracted from the red alga *Asparagopsis taxiformis* present in the Strait of Messina. MTT tests did not show cytotoxic activity of algal extracts on DH82, VERO, L929, MDCK and U937 cell lines. The extracts were inoculated at different concentrations in cultures of *L. infantum* (MHOM / IT / 80 / IPT1) showing that they have a remarkable activity even at low concentrations.

Type of innovation: Service/know how innovation

Description of innovative features / Competitive advantages

There is currently no vaccine and the treatment of leishmaniasis is not curative. Unlike the active compounds used in drugs on the market (e.g. pentavalent antimonials, pentamidine and amphotericin B), which are of synthetic origin and with high toxicity at effective therapeutic doses, the product here proposed has a natural origin and is not citotoxic. In fact, polysaccharides and algal biometabolites play an important role in pharmaceutical applications due to their intrinsic biocompatibility and potential low cost. Furthermore, data on the anti-leishmanial potential of marine algae are extremely limited to some non-Mediterranean strains (*Leishmania donovani, L. mexicana, L. major* and *L. amazonensis*). Our study represents the first investigation of the application of algal polysaccharides and biometabolites on the Mediterranean strain *L. infantum*. From an environmental point of view, technology wants to propose the ecosustainable use of those algal species which, by producing high biomass in the Venice Lagoon, cause significant inconvenience to human activities, within the framework of a Bio-based Circular Economy process.

Reference market: Total innovation, Creation of new markets

Development stage: Idea

TRL: 1, 2

Market positioning: Italian, European, International

Partner required: Cooperation in national /european / international project

Key words: Polysaccharides, Biometabolites, Marine algae, Leishmania infantum, Natural drugs

Url: *https://promott.cnr.it/en/technology/98/algal-polysaccharides-and-biometabolites-aspotential-drugs-against-leishmaniasis*

UNDERWATER IMAGES ACQUISITION AND PROCESSING SYSTEM

 # Record card: 99

Thematic areas

ICT & Electronics / Sensor/multi-sensor technology, instrumentation
ICT & Electronics / Optics & Acoustic
ICT & Electronics / Internet of Things
ICT & Electronics / Artificial Intelligence
ICT & Electronics / Optoacustic sensors, Optoelectronic devices
ICT & Electronics / Information processing, information system, workflow management
Aerospace and Earth Science / Oceanography
Agrifood / Marine resources
Tourism, social sciences and cultural heritage / Technologies for preservation of cultural heritage
Tourism, social sciences and cultural heritage / Education & learning
Tourism, social sciences and cultural heritage / Entertainment
Tourism, social sciences and cultural heritage / Socio-economic models
Tourism, social sciences and cultural heritage / Multimedia technologies

Description

This form describes a programmable, autonomous and stand-alone imaging system for the acquisition and processing of images containing subjects whose size is larger than 1cm (e.g. gelatinous zooplankton, fishes, litter, manufacts), form the seafloor or along the water column, in shallow or deep waters. It is capable to recognize and classify the image content through pattern recognition algorithms that combine computer vision and artificial intelligence methodologies. The relevant content of the acquired images is stored on board or transmitted through the communication facilities of the imaging system (e.g. acoustics or satellite modem). The use of such an image acquisition and processing system, installed on fixed or mobile platforms (e.g. cabled or stand-alone observatories, lander, AUV, ARGO Floats, drifter buoys, sea gliders), allows for low cost and long-lasting underwater monitoring activities at local or regional scale.

Type of innovation: Product innovation, Product / process innovation in integration with an already existing technology

Description of innovative features / Competitive advantages

The underwater video systems currently in use for marine monitoring mainly consist of imaging devices installed on fixed platforms wired to a land station (cabled observatories like EMSO or Ocean Network Canada) or operated or deployed by surface vessels, like for example ROV, AUV. The use of wired stations and vessels makes the monitoring activity expensive and necessarily limited in time and space. The proposed intelligent imaging device overcomes all these limits. It has conceived for stand-alone applications; it has a small volume and weight and can be easily installed onboard mobile or fixed platforms. It performs autonomous monitoring activities for long periods (> 24 months), and across wide geographical areas, as it can be easily located and relocated.

Reference market: Incremental innovation, Impacts on existing markets

Development stage: Prototype

TRL: 5, 6, 7

Advantages: Product/process/service/technology optimization, Cost reduction

Patented technology: Yes

Country/ies: Norway, Spain, Italy, France, Germany, Ireland, UK, Netherlands

Technology validation/demonstration: External validation

Market positioning: Italian, European

Partner required: Enterprise, Public research center/university, Seed capital, Cooperation in national /European / international project

Key words: Marine video monitoring, Artificial Intelligence, Autonomous underwater vehicles, Marine observatories, ARGO Float

Url: *https://promott.cnr.it/en/technology/99/underwater-images-acquisition-and-processingsystem*

HIGH-CONTENT CELLULAR IMAGING FOR PHARMACOLOGICAL AND BIOTECHNOLOGICAL APPLICATIONS

 # Record card: 100

Thematic areas

Health & Biotech / Diagnostic, Medical imaging & advanced bioimaging

Health & Biotech / Medical imaging & equipment

Description

The Nikon reference centre at IBPM (www.imagingplatformibpmcnr.it) is a microscopy platform for high resolution imaging of fixed samples and live cells (time-lapse video recording, both wide eld and confocal spinning disk). Multimodal (fluorescence and transmitted light) and multidimensional (in x,y,z, 4 wavelengths, over time) acquisition modes are in place. By integrating novel cellular models and imaging methodologies we have achieved high automation levels in acquisition modalities and automated analysis pipelines for large datasets (thousands per experiment, high throughput) based on machine learning and artificial intelligence approaches (high content information). We can thus provide (i) novel tools to the scientific community and the biomedical industry to understand the complexity and heterogeneity of the cellular response to treatments of pharmacological interest and (ii) collaboration to companies operating in the imaging eld in technological projects.

Type of innovation: Service/know how innovation

Description of innovative features / Competitive advantages

Single cell high throughput microscopy, coupled with complex analyses of multidimensional data, offers significant advantages in pharmacological and biotechnological applications:

- capability of resolving spatio-temporal features of biological processes (e.g. cell division, death and differentiation, drug uptake) associated to application versatility;
- unique ability to identify rare events within a heterogeneous cell population;
- high reproducibility of gained information, translatable into quantitative measurements through the development of automated workflows.

These features can increase the effectiveness and speed of drug response studies in cellular models and hence facilitate further pre-clinical and clinical investigations, thus providing the biomedical sector with an original process improvement, and the imaging companies with a platform for the pre-commercial validation of accessories and software.

Reference market: Incremental innovation, Impacts on existing markets, Creation of new markets

Development stage: Industrialization

TRL: 7, 8

Advantages: Product/process/service/technology optimization

Patented technology: No

Technology validation/demonstration: External validation

Market positioning: Italian, European, International

Partner required: Enterprise, Private research center, Cooperation in national /European / international project

Key words: Microscopy, High content imaging, Drug validation, Process automation

Url: *https://promott.cnr.it/en/technology/100/high-content-cellular-imaging-for-pharmacologicaland-biotechnological-applications*

INJECTABLE HYDROGELS BASED ON AD-HOC SYNTHESIZED POLY(URETHANE)S FOR BIOMEDICAL APPLICATIONS

 # Record card: 101

Thematic areas

Health & Biotech / Micro and nanotechnology related to biological sciences
Health & Biotech / Bio-medicals
Health & Biotech / New therapies
Health & Biotech / Nanomedicine
Health & Biotech / Medical Device
Health & Biotech / Regenerative Medicine
Materials / Processes of production & treatment of materials
Materials / Plastics, polymers

Description

The herein described technology aims at the development of a platform of injectable hydrogels for application as drug carriers for localized delivery or in the regenerative medicine eld. The use of ad-hoc synthesized poly (ether urethane) s (PEUs) as hydrogel forming materials is a common property which characterizes all the systems belonging to this platform. By exploiting PEU LEGO-like structure, a wide plethora of PEUs can be synthesized containing specific functional groups or constituent blocks which result in hydrogels with well-defined physico-chemical properties (e.g., stimuli-responsiveness to for example temperature ot light irradiation, biodegradation, residence time upon injection). PEU high versatility thus allows to engineer both physical and chemical hydrogels according to their final application and exhibiting a high personalization potential which makes them able to perfectly meet patient's requirements (e.g., type of therapeutic agents, dosage, release kinetics).

Type of innovation: Product innovation, Process innovation, Product / process innovation in integration with an already existing technology

Description of innovative features / Competitive advantages

The cutting-edge features of the proposed technology rely on the high versatility of its formulations which allows to finely tune their properties to maximize their therapeutic efficacy. Through a proper selection of hydrogel constituents both physical and chemical systems can be designed, with the potential to be loaded with a wide array of different therapeutic agents (e.g., hydrophilic and hydrophobic drugs, biomolecules) at high concentration. These therapeutic agents will be then released *in loco* with a sustained and prolonged kinetics according to the specific requirements of the targeted application. In addition, the characteristic injectability of the formulations and their ability to undergo a post-injection gelation make them able to perfectly fill each biological cavity. Differently from the currently employed devices, the formulations belonging to the platform hold a huge personalization potential in terms of type of encapsulated payload, dosage and release timing.

Reference market: Incremental innovation, Impacts on existing markets

Development stage: Prototype

TRL: 4, 5

Advantages: New product/process/service/technology, Product/process/service/technology optimization

Patented technology: No

Technology validation/demonstration: Internal validation

Market positioning: Italian, European, International

Partner required: Enterprise, Seed capital, Cooperation in national /European / international project

Key words: Injectable hydrogels, Polyether, Polyurethane, Stimuli-responsiveness, Drug release, Regenerative medicine

Url: *https://promott.cnr.it/en/technology/101/injectable-hydrogels-based-on-ad-hoc-synthesizedpolyurethanes-for-biomedical*

MANUFACTURING OF NANOCOMPOSITE MEMBRANES FILLED WITH WET-JET MILLING-EXFOLIATED 2D CRYSTALS TO BE USED IN MEMBRANE PROCESSES DEDICATED TO WATER DESALINATION

 # Record card: 102

Thematic areas

Energy and environmental sustainability / Environmental engineering/technologies
Materials / Photo-active & graphene-based materials
Agrifood / Marine resources
Materials / Composite and hybrid materials
Chemicals & Physics / Separation technologies
Chemicals & Physics / Sustainable substances and green chemistry
Energy and environmental sustainability / Pollution treatment (air, soil, water)

Description

The procedure enables the fabrication of nanocomposite membranes filled with suitable amounts of exfoliated bidimensional crystals. These are obtained with an advanced wet-jet milling technique, which provides desired thickness and lateral size of nanofillers through the pulverization and colloidal homogenization of bulk nanomaterials. The bidimensional crystals are dispersed in fluids and suitably delivered inside polymeric matrixes exhibiting a singular morphology. The nanocomposite membranes work as active interfaces when equipping membrane distillation and membrane crystallization devices, thus yielding enhanced productivity-efficiency trade-off at low energy consumption. Fresh water can be produced in a larger amount while salt crystals much more uniform in size and shape can be recovered through the implementation of two membrane technologies greener and more sustainable than traditional ones.

Type of innovation: Product innovation, Process innovation, Product / process innovation in integration with an already existing technology

Description of innovative features / Competitive advantages

Membrane distillation and membrane crystallization technologies provide substantial and eco-sustainable solutions to manage and reuse natural resources such as water and minerals from seawater, rivers and lakes. A scale up of these technologies on industrial size is actually limited by the scarcity on the market of membranes with suitable structural and chemical features enabling one to shift competitively the productivity-efficiency trade-off beyond the state of the art. This research wants to fill the gap existing between commercial membranes and new scalable-engineered 2D materials-enabled membranes easy to scale up. The innovation is the design of new membranes with complementary functions, which afford assisted separation mechanisms for more productive and fruitful water desalination through scalable, eco-sustainable and cost-effective membrane operations.

Reference market: Incremental innovation, Impacts on existing markets

Development stage: Feasibility

TRL: 3, 4

Advantages: Product/process/service/technology optimization, Cost reduction

Patented technology: Yes

Country/ies: Italy

Publication of technology: Published

Technology validation/demonstration: Internal validation

Market positioning: Italian, European, International

Partner required: Enterprise, Cooperation in national /european / international project

Key words: Water Desalination, Membranes, Graphene and 2D Materials, Membrane Distillation and Crystallizzation, Green technologies

Url: *https://promott.cnr.it/en/technology/102/manufacturing-of-nanocomposite-membranes- lledwith-wet-jet-milling-exfoliated-2d*

SMART POLYCRYSTALS

 # Record card: 103

Thematic areas

Materials / Ceramic materials
Materials / Optical materials
Health & Biotech / Medical imaging & equipment
Additive and advanced industrial manufacturing

Description

The proposing team that works at CNR ISTEC has recently patented a technology for the production of the Smart Polycrystals (SP), i.e. transparent YAG-based ceramic polycrystals ($Y_3Al_5O_{12}$) variably doped with rare earths ions and transition metals ions. The SPs solve the problem of the reduction of the efficiency in the solid-state laser systems caused by the inhomogeneous heating of the single crystals during the emission process. By replacing the single crystals with the SPs, we drastically reduce these thermal effects. Thanks to an innovative additive manufacturing process, we can obtain the defect-free microstructures needed for the transparency, as well as layered or graded distributions of the dopant needed for the heating control. SPs have reached a TRL 4, validation in laboratory. The patent is owned by CNR and protects the product and process.

Type of innovation: Product innovation, Process innovation

Description of innovative features / Competitive advantages

The Smart Polycrystals (SPs) can be produced at a fraction of the production costs of single crystals, and with complex structures and a designed dopant distribution. This competitive advantage meets specific application needs to increase performance, which are currently unsatisfied due to the lack of techniques that go beyond the creation of simple double layered components. An additional advantage is the reduced environment impact of the production process, that leads also to an additional cost reduction. The process temperatures are lower, and the process duration is shorter than those needed for the production of single crystals. The SPs are near-net-shape with limited production waste and can be designed and produced in a way that allows to regenerate them at the end of their life, according to the criteria of the circular economy. Finally, 3D printing allows components to be miniaturized with further savings in raw materials.

Reference market: Total innovation, Impacts on existing markets

Development stage: Prototype

TRL: 4

Advantages: New product/process/service/technology

Patentable technology: Yes

Patented technology: Yes

Country/ies:Italy

Technology validation/demonstration: External validation

Market positioning: Italian, European, International

Partner required: Enterprise, Seed capital, Cooperation in national /european / international project

Key words: Ceramic, Polycrystal, Transparent, Solid state laser

Url: *https://promott.cnr.it/en/technology/103/smart-polycrystals*

SHARED INFORMATION SYSTEM WITH IDENTIFICATION DATA PROTECTION

 # Record card: 127

Thematic areas

ICT & Electronics
ICT & Electronics / Information processing, information system, workflow management
ICT & Electronics / IT and Telematics applications
ICT & Electronics / Cybersecurity
ICT & Electronics / Network technology, network security

Description

Network structures that require the use of a common database are affected by the risk of processing identification data that are necessary for sharing information and updating and processing data with equal access level between the network nodes. However, this sharing could lead risks of vulnerability when identification data are exchanged between the nodes of the network. The proposed information system involves the exchange of information by encrypting the identification data with an MD5 Hashing procedure (RFC1321). The unique code of each record is generated by entering three identifying information held by the nodes of the network. The encrypted ID generated is not reversible. In this way it is possible to eliminate the risk of loss of identification information through data breach, and at the same time to share information related to the correct identity to the network nodes who are aware of the encrypted ID.

Type of innovation: Product / process innovation in integration with an already existing technology

Description of innovative features / Competitive advantages

The Privacy Regulation (both in force and the laws prior to 2016), whose main purpose is protecting the confidentiality of information that could harm the interested parties, has involved a series of technological adjustments to allow the implementation of activities based on the use individual data. When there is a need to exchange confidential as safely as possible, confidentiality can be a very difficult obstacle to overcome. The proposed system has found the most convenient way for a secure data exchange within a closed network at whose nodes there are properly trained operators. The main advantage lies in the fact that the telematic method can be used for the exchange of pseudonymized information which makes the transmission immediate, controlled and traceable even in the presence of confidential information.

Reference market: Incremental innovation, Impacts on existing markets

Development stage: Prototype

TRL: 8, 9

Advantages: Product/process/service/technology optimization

Patentable technology: No

Patented technology: No

Technology validation/demonstration: External validation

Market positioning: Italian, European, International

Partner required: Enterprise, Public research center/university, Cooperation in national /european / international project

Key words: Information system, ident cation, MD5 Hashing procedure, Sharing data in a network, Risk reduction

Url: *https://promott.cnr.it/en/technology/127/shared-information-system-with-identi cation-dataprotection*

SUNSCREEN OF MARINE ORIGIN BASED ON IRON-MODIFIED HYDROXYAPATITE

 # Record card: 128

Thematic areas

Chemicals & Physics

Chemicals & Physics / Micro and nanotechnology related to physical, chemical and exact sciences

Chemicals & Physics / Sustainable substances and green chemistry

Energy and environmental sustainability - Energy and environmental sustainability / Renewable sources

Materials - Materials / Ceramic materials

Health & Biotech - Health & Biotech / Care, Hygiene, Cosmetics

Description

The proposed technology is about the development of an innovative sunscreen obtained from cod fish bones, according to the principles of the circular economy. The sunscreen is a reddish powder, which is constituted of hydroxyapatite (a calcium phosphate main component of human bones) modified with iron. It is prepared with a simple and easily scalable process (treatment of the bones in Fe solution and successively at T = 700 oC) and could be adapted for bones of other fishes. The powder absorbed the UV radiation in the whole range and it kept this property when incorporated into a cream. For this performance the sunscreen could be classified as 5 stars (maximum) according to the Boots classification system. The Sun Protection Factor (SPF) of the cream, however, was lower than for a commercial inorganic sunscreen.

The powder was incorporated into chitosan, a material used in biomedicine; the composites showed antibacterial and UV-protection properties, suitable for wound dressing.

Type of innovation: Product innovation

Description of innovative features / Competitive advantages

One advantage of this sunscreen is its non-toxicity; it is in fact made of is hydroxyapatite, a compound already present in our body (main component in human bones).

This product is also not harmful for the environment (marine waters) because, differently from other inorganic sunscreens (TiO_2, ZnO), is not photocatalytic, i.e. it does not generate free radicals when irradiated. The accumulation in the environment of photocatalytic sunscreens is a cause of growing concern.

The sunscreen is produced from by-products of the food industry; overall its impact on the environment is lower than other commercial sunscreens.

This sunscreen can also be employed in combination with other sunscreens, to have a synergistic effect.

The particles of the powder are > 100 nm; this is an advantage as new EU regulations make compulsory to indicate on the label when smaller particles are used (smaller particles are not well accepted by the consumers).

Reference market: Impacts on existing markets

Development stage: Prototype

TRL: 4

Advantages: New product/process/service/technology

Patentable technology: No

Patented technology: Yes

Country/ies: Italy, Europe, US

Publication of technology: Published

Technology validation/demonstration: Internal validation

Market positioning: Italian, European, International

Partner required: Enterprise, Public research center/university, Private research center, Cooperation in national /european / international project

Key words: Sunscreen, UV protection, Hydroxyapatite, Circular economy, Fish industry by-product

Url: *https://promott.cnr.it/en/technology/128/sunscreen-of-marine-origin-based-on-iron-modiedhydroxyapatite*

LIFESHELL, WOOD-BASED ANTI-SEISMIC FURNITURE

 # Record card: 129

Thematic areas

Aerospace and Earth Science - Aerospace and Earth Science / Seismology
Materials - Materials / Wood products
Energy and environmental sustainability / Building materials
Agrifood - Agrifood / Forestry
Health & Biotech - Health & Biotech / Smart Devices for Health and Wellness
Energy and environmental sustainability
Tourism, social sciences and cultural heritage / Safety and security
Energy and environmental sustainability / Natural disasters - Energy and environmental sustainability / Simulation - Tourism, social sciences and cultural heritage
Tourism, social sciences and cultural heritage / Technologies for preservation of cultural heritage Bioeconomy

Description

Lifeshell is an anti-seismic furniture construction concept, which can be used for making wardrobes, tables, desktops, beds. It's made by timber-based panels: highly resistant and flexible, relatively lightweight and inexpensive. Lifeshell benefits from the natural wood elasticity and from smart connections for dissipating the great impact energies occurring during an earthquake. Lifeshell has been designed for resisting partial building collapses, and to provide a safe shell where inhabitants can find refuge. This system allows increasing the survival chances especially in old not-anti-seismic buildings, potentially avoiding injuries and death. The furniture is build by using 3 to 5 layers Cross Laminated Timber panels 80 or 100 mm thick. Connections are performed by using wooden house hardware. Several versions are available for Education (school and lab desks), Residential (dining table, desk, wardrobe, bed), Oce and Industry (meeting table, office desk, work bench). The Creative Commons CC BY 4.0 licence allows to share (copy and redistribute) Lifeshell in any medium or format, adapt, remix, transform, and build upon the material, for any purpose, even commercially, by giving the appropriate credit to authors.

Type of innovation: Product / process innovation in integration with an already existing technology

Description of innovative features / Competitive advantages

The inventor desired to make this technology available to as many persons as possible. This also meant maintaining the purchase costs as low as possible: the materials are relatively inexpensive, there are no royalties for the patent and last but not least, being copyright free means potential competition among industrial producers. The release with the Creative Commons CC BY 4.0 allows anybody to make, modify, sell this concept. The only requirement is to cite the author and to release similarly the derivative design. Said so, there is still an interesting business opportunity for wood industries. Enterprises are free to modify the concept (which is very plain) adopting design solutions, new accessories, new coating materials etc. This technology should not be used in substitution of a proper building assessment and consolidation.

Reference market: Incremental innovation, Impacts on existing markets, Creation of new markets

Development stage: Prototype

TRL: 6

Advantages: Product/process/service/technology optimization

Patentable technology: No

Patented technology: No

Publication of technology: Published

Technology validation/demonstration: Internal validation

Market positioning: Italian, European, International

Partner required: Enterprise, Public research center/university, Private research center, Cooperation in national /european / international project

Key words: Anti-seismic, Furniture, Cross laminated timber, Shelter, Creative commons

Url: *https://promott.cnr.it/en/technology/129/lifeshell-wood-based-anti-seismic-furniture*

SOFTWARE FOR SIMULATING THE DYNAMICS OF INSECT PESTS IN AGRICULTURE

 # Record card: 130

Thematic areas

Energy and environmental sustainability
Energy and environmental sustainability / Ecology & Biodiversity
Energy and environmental sustainability / Simulation
Agrifood
Agrifood / Food quality & safety

Description

The software is based on mathematical models able of simulating the time evolution of the different stages of a pest population starting from environmental data collected from weather stations located in an area of interest and information regarding the development stage of the host plant. The models are of two types: phenological, which provides information on the stages population as a function of time and demographic which also allows to know the abundance of each population stage. The software, which can be used even by users without too much mathematical and computer knowledge, is easily adaptable to any invasive insect pest. An important application concerns eld treatments with pesticides. Using weather forecast it is possible to determine in advance when the population reaches an alarm level at which it is necessary to treat.

Type of innovation: Service/know how innovation

Description of innovative features / Competitive advantages

Predictive models for pests in agriculture have been used since the beginning of the last century. In the regional integrated production programs of the Emilia Romagna region, the distributed delay model is used to describe the insects' phenology. The phenological models we use are more flexible than the distributed delay model as they allow for more information on the biology of the species to be taken into account. Furthermore, where possible, it is interesting to develop a demographic model that can also provide information on the abundance of species. The demographic model is currently little used in integrated pest management programs because it requires greater knowledge of the biology of the species, but we believe that this model is more efficient in determining an optimal strategy for phytosanitary treatments aimed at reducing the use of pesticides.

Reference market: Impacts on existing markets

Development stage: Feasibility

TRL: 4

Advantages: New product/process/service/technology

Patentable technology: No

Patented technology: No

Publication of technology: Published

Technology validation/demonstration: Internal validation

Market positioning: Italian, European, International

Partner required: Public research center/university, Private research center, Cooperation in national /european / international project

Key words: Insect pests dynamics, Phenological and demographic models, Integrated pest management, Pesticides reduction

Url: *https://promott.cnr.it/en/technology/130/software-for-simulating-the-dynamics-of-insectpests-in-agriculture*

OCHEMDB: OPEN CHEMISTRY DATABASE

 # Record card: 131

Thematic areas

Chemicals & Physics

Chemicals & Physics / Inorganic substances

Chemicals & Physics / Organic substances

Description

The Open Chemistry Database, OChemDb, is a web portal for the research and analysis of Crystall chemical information relating to organic, inorganic, metallorganic compounds, and provides statistical information on bond distances, bond angles, torsion angles, types of atoms and space groups. To obtain the above information, OChemDb queries a database, appropriately designed, that contains crystalline structures already resolved. Its ease of use is extremely useful for structural chemistry, in particular during the nal phase of checking and evaluating the reliability of the structural solution obtained and relating to a new structure, to investigate the nature of a 'doubtful' chemical bond, for estimate reasonable bond distances and angles to be used as chemical constraints in a structural refinement process. OChemDb is therefore very useful for research groups and companies interested in the knowledge of the crystalline structure of materials, for example chemical and pharmaceutical companies.

Type of innovation: Service/know how innovation

Description of innovative features / Competitive advantages

Compared to other statistical analysis software on required crystallochemical information, specifically bond distances and angles, torsion angles, types of atoms and spatial groups, OChemDb, at national and international level, offers a simplicity of use supported by a graphical user interface. friendly. These features allow you to get quick answers to effective use even by nonexperts. An important aspect is also represented by the fact that the API layer implemented in OChemDb allows to integrate the data stored in third-party software.

Reference market: Impacts on existing markets

Development stage: Industrialization

TRL: 8

Advantages: New product/process/service/technology

Patentable technology: No

Patented technology: No

Publication of technology: Published

Technology validation/demonstration: External validation

Market positioning: Italian, European, International

Partner required: Enterprise, Private research center

Key words: crystallography, Bond distance, Bond angles, Statistics, Torsions

Url: *https://promott.cnr.it/en/technology/131/ochemdb-open-chemistry-database*

NUTRITION AND HEALTH PLATFORM

 # Record card: 132

Thematic areas

Agrifood

Health & Biotech

Agrifood / Nutrition & health

Agrifood / Food quality & safety

Description

The systems simulate, with high reproducibility, the conditions that occur in the different compartments of the gastrointestinal tracts and are promising to accurately mimic the digestive process, with the possibility to evaluate bio accessibility and bioavailability. Moreover, the systems permit to study the synergic and reciprocal effects between the bioactive compounds characteristic of food and intestinal microbiota. This platform provide support to innovative studies on the potentially positive effects of foods on health, beyond and in particular to investigate the mechanisms underlying the linkage between foods and human health. In this contest, the mission of the platform is:

- the identification and characterization of food matrix and its nutraceutical compounds;
- the use of multi-compartment dynamic digestion systems simulating the different compartments of the gut, to mimic the digestive process and evaluate nutrient bio accessibility, coupled with intestinal cell lines for the bioavailability evaluation of the nutrients.
- the study of gut microbiota to understand the complex food/microbiome interactions and aspromising target for clinical interventions.

Type of innovation: Process innovation, Service/know how innovation

Description of innovative features / Competitive advantages

The use of a dynamic multi-compartment gastric model offers the possibility to simulate both the biochemical and mechanical aspects of human gastric digestion in a realistic time-dependent manner. The platform is suitable for mechanistic studies and hypothesis building due its controlled conditions, reproducibility and ease of sampling at the site of interest. Its integration with a metagenomic and metabolomic platform provides an avenue to interrogate the complex interplay of food matrix/gut microbiota in terms of analysis of microbial population dynamic and of metabolic output of such complex biological system. This technology will not be limited to the users directly working in the food and nutrition areas, but will also from the medical and pharmaceutical sectors, where there is a growing interest on the role of nutrition in diseases and on the interaction of the diet with specific medical treatments. At the same time, this technology will be in support of policy decisions to Develop national food-based dietary guidelines that de ne context-specific Sustainable Healthy Diets by taking into account the social, cultural, economic, ecological and environmental circumstances associated to the high incidence of diet-related diseases.

Reference market: Incremental innovation, Impacts on existing markets

Development stage: Feasibility

TRL: 4

Advantages: Product/process/service/technology optimization

Patentable technology: Yes

Patented technology: No

Technology validation/demonstration: Internal validation

Market positioning: Italian, European, International

Partner required: Enterprise, Public research center/university, Private research center, Cooperation in national /European / international project

Key words: Multi-compartment dynamic digestion systems, Gut microbiota, Omics, Bioactive compounds

Url: *https://promott.cnr.it/en/technology/132/nutrition-and-health-platform*

A DNA-BASED BIOSENSOR FOR THE FAST AND SENSITIVE DETECTION OF CONTAMINANTS IN BIOLOGICAL SAMPLES

 # Record card: 133

Thematic areas

Agrifood
Agrifood / Food quality & safety
Agrifood / Nutrition & health
Health & Biotech
Health & Biotech / Diagnostic kits
Health & Biotech / Biosensors

Description

A biosensor based on magnetic microspheres functionalized with a DNA-aptamer was developed for the specific biomonitoring of biological contaminants (mycotoxins) in urine.
The biosensor is used in a test tube into which the diluted urine sample is added. The biosensor has been validated for the monitoring of ochratoxin (OTA) with high sensitivity and selectivity thanks to the presence of a DNA sequence (aptamer), specifically designed to capture traces of the analyte (up to 10-12 ng/mL of OTA), and to a DNA-based system specifically designed to hyper-amplify the detection signal, in 4 hours, and at a constant temperature of 30 °C.
The OTA is concentrated in the sample and its presence displayed as a blue tint in the solution. It does not require special equipment other than pipettes and a small portable incubator. The biosensor can also be used for quantitative analysis using a portable photometer, with recoveries greater than 95%, high specificity and precision.
The biosensor is being validated for the analysis of other contaminants in food matrices or biological samples.

Type of innovation: Product / process innovation in integration with an already existing technology

Description of innovative features / Competitive advantages

Mycotoxins are biological contaminants of food and feed commonly analyzed by chromatographic techniques that require expensive and cumbersome equipment and skilled operators. The biosensor, on the other hand, represents a valid alternative thanks to its high portability and ease of use, as well as a reduction in costs and analysis times. We have shown that the results obtained with the biosensor are comparable to those obtained with the standard chromatographic methods. Another strength of the biosensor is the ability to concentrate the analyte in the sample, thereby increasing sensitivity. The biosensor does not require any puri cation of the urine sample, thus speeding up the analysis time. The portability of the biosensor allows its use on site, facilitating monitoring studies, and allowing the implementation of contamination containment measures in a short time. Due to the plasticity and high versatility of the biosensor structure, it can be used for the detection of other contaminants such as pesticides, viruses, drugs, etc., in a simple way, by modifying only one component of the biosensor. It differs from other diagnostic systems for its high sensitivity and applicability in complex matrices such as urine samples.

Reference market: Incremental innovation, Impacts on existing markets

Development stage: Feasibility

TRL: 4

Advantages: Product/process/service/technology optimization, Cost reduction

Patentable technology: No

Patented technology: No

Publication of technology: Published

Technology validation/demonstration: Internal validation

Market positioning: Italian, European, International

Partner required: Enterprise, Cooperation in national /European / international project

Key words: Contaminants, Mycotoxins, Biosensor, Safety, Biomonitoring

Url: *https://promott.cnr.it/en/technology/133/a-dna-based-biosensor-for-the-fast-and-sensitivedetection-of-contaminants-in*

VACUUM TIGHT THREADED JUNCTION (VTTJ)

 # Record card: 134

Thematic areas

Aerospace and Earth Science
Energy and environmental sustainability
Energy and environmental sustainability / Nuclear fission/nuclear fusion
Additive and advanced industrial manufacturing
Additive and advanced industrial manufacturing / Vacuum/High vacuum technologies
Materials

Description

The working principle of VTTJ is extremely simple. Two parts (at least one with tube shape) are screwed one into the other with a mechanical interference that creates a metallic seal. One part presents a cylindrical slot, the other presents a conical ring, whose diameter is slightly larger than the one of the cylindrical slot. When the two parts are screwed together, a plastic deformation occurs in the mechanical interference region. The plastic deformation generates an absolutely hermetic seal, as demonstrated by several tests carried out on various geometries of the junction. To avoid unscrewing of the two parts, and to make the junction compatible with high thermal and/or structural loads, one can proceed with a finishing phase using galvanic electrodeposition of copper.

Type of innovation: Process innovation

Description of innovative features / Competitive advantages

The new VTTJ technique permits to manufacture metallic junctions having a perfect seal (compatible with the requirements of high vacuum environments) that is reliable in time also in presence of high temperatures and high structural loads. The process is carried out completely in cold conditions, hence in any phase the materials are prevented from possible damages due to overheating. On the other hand, using any other existing technique able to give a vacuum compatible seal (like friction welding, electron beam welding, brazing etc.) there is always a certain overheating in the junction area, with possible cracks or other types of degradation of the materials (annealing, recrystallization, inclusions etc.).

Reference market: Total innovation, Impacts on existing markets, Creation of new markets

Development stage: Prototype

TRL: 8, 9

Advantages: New product/process/service/technology, Cost reduction

Patented technology: Yes

Country/ies: Italy

Technology validation/demonstration: External validation

Market positioning: Italian, European, International

Partner required: Enterprise

Key words: Vacuum, Tight, Threadec, Junction

***Url**: https://promott.cnr.it/en/technology/134/vacuum-tight-threaded-junction-vttj*

MODULAR ROBOTIC DEVICE FOR BILATERAL NEUROMOTOR UPPER LIMBS REHABILITATION

 # Record card: 135

Thematic areas

Health & Biotech
Health & Biotech / Bio-medicals
Health & Biotech / Smart Devices for Health and Wellness
Health & Biotech / Medical Device
ICT & Electronics
ICT & Electronics / Robotics and control systems
ICT & Electronics / Artificial Intelligence

Description

Portable robotic device for bilateral neuromotor rehabilitation. An appropriate mechanical structure and a series of interchangeable accessories suitably designed allow the execution of various motor gestures of the upper limbs, involving different articulations and muscles. The possibility of being used with both limbs contributes to the recovery of motor coordination and facilitates the mechanism of brain plasticity. Some rotary axes the device is equipped with are motorized and sensorized. This allows the implementation of adaptive and personalized control algorithms, to support the patient's action according to his motor skills and therapeutic needs. The device can be securely constrained to a generic horizontal surface, such as a table or desk, to facilitate its portability and use, also in telerehabilitation contexts.
Further information in this video https://youtu.be/RKxjNGPzA4A

Type of innovation: Product innovation

Description of innovative features / Competitive advantages

The solution allows the execution of various motor gestures during bilateral rehabilitation exercises, combining high portability and simplicity of implementation, contributing to cost containment and use in telerehabilitation context. There are several technological solutions for rehabilitation, but few are dedicated to bilateral rehabilitation and there are currently no solutions on the market able to actively assist, as needed, musculoskeletal structures of the shoulder, elbow and wrist, allowing different movements. Compared to rehabilitation solutions based on the use of motion tracking sensors only, the presence of motorized components and the use of appropriate control algorithms allow their use even by patients with limited motion control capacity. This also allows the customization of the action of the device according to the patient's motor skills.

Reference market: Incremental innovation, Impacts on existing markets

Development stage: Prototype

TRL: 4, 5

Advantages: New product/process/service/technology, Cost reduction

Patentable technology: Yes

Patented technology: No

Publication of technology: No

Technology validation/demonstration: Internal validation

Market positioning: Italian, European, International

Partner required: Enterprise, Seed capital, Cooperation in national /european / international project

Key words: Robotic rehabilitation, Bilateral rehabilitation, Upper limb, Assist-as-needed control, Teleriahbilitation

Url: *https://promott.cnr.it/en/technology/135/modular-robotic-device-for-bilateral-neuromotorupper-limbs-rehabilitation*

PHYTODEPURATION MODULE AND RELATED PLANT – HYDRO FERN

 # Record card: 136

Thematic areas

Energy and environmental sustainability
Energy and environmental sustainability / Pollution treatment (air, soil, water)
Energy and environmental sustainability / Environmental engineering/technologies Bioeconomy

Description

The invention relates to the water puri cation sector; it refers to a phytodepuration module and to a plant including this module. The objective is decontamination and recovery of drinking water from contaminated springs and wells, thermal, rainwater, wastewater and industrial wastewater. Phytodepuration tanks are known which use ferns to decontaminate water, but have the limits of requiring large surfaces and / or long treatment times. This invention provides a modular structure developed vertically, made by a plurality of mutually connected tanks suitable for plants and containing the water to be treated. Vertical hydroponics plants are known, but for purposes other than phytodepuration. One purpose of the invention is to optimize drinking water dearsenification, using such systems for the cultivation of the P. vittata ferns, maximizing the number of plants and reducing the occupied area.

Type of innovation: Product innovation

Description of innovative features / Competitive advantages

1) Eco-sustainable solution (Nature Based Solution);
2) Reduction of decontamination costs by 50% compared to current technologies;
3) Reduction of CO2 emissions;
4) Reduction of chemical waste;
5) Can be combine with filter systems;
6) Urban and peri-urban environment Improve.

Reference market: Total innovation, Impacts on existing markets, Creation of new markets

Development stage: Prototype

TRL: 4, 5

Advantages: New product/process/service/technology, Cost reduction

Patented technology: Yes

Country/ies: Italy

Technology validation/demonstration: Internal validation

Market positioning: Italian, European, International

Partner required: Enterprise, Seed capital, Cooperation in national /european / international project

Key words: Hydroponic vertical colture, Phytoextraction, Arsenic, Pteris vittata, Water

Url: *https://promott.cnr.it/en/technology/136/phytodepuration-module-and-related-plant-hydrofern*

NEW COMPOUNDS WITH SENOLYTIC ACTIVITY

 # Record card: 137

Thematic areas

Health & Biotech
Health & Biotech / Micro and nanotechnology related to biological sciences
Health & Biotech / Bio-medicals
Health & Biotech / New therapies
Health & Biotech / Nanomedicine
Health & Biotech / Development of new drugs

Description

With the advent of senolytic agents, capable of selectively removing senescent cells in “aged” tissues, the perception of age-associated diseases has changed from being an inevitable to a preventable phenomenon of human life. The present invention is part of this research topic with the identification of molecules with potential pro-apoptotic activity, specifically with senolytic activity. The computational approach adopted, is based on combining ligand-base and structure-based virtual screening. The in vitro assays have been carried out by developing a senescence model through serial passages of primary human fetal lung cells IMR90. In particular, 14 molecules, identified by virtual screening, revealed a higher, lower or absent pro-apoptotic activity in senescent cells and no effect in cell populations with lower number of passages. Of this series, two compounds revealed a marked senolytic capacity in vitro, reducing the aging population by about 50% in the first 48 hours of exposure to the drug. The compounds are now under evaluation in vivo, in an aging modelcarried out in mice older than 24 months.

Type of innovation: Product innovation

Description of innovative features / Competitive advantages

The molecules of interest fall within the topic of senolytic agents, ie compounds that kill the senescent cells within living organisms. Other senolytic agents are known in the literature which share the putative molecular target of the molecules considered in this invention, namely the Heat shock protein 90 (HSP90). The molecules we have identified as potential senolytic drugs have the advantage of selectively promoting programmed death (apoptosis) and the inhibition of replication potential in the cellular senescence model adopted. They also showed reduced toxicity when compared with known compounds, using in vitro models. We have begun in vivo studies and will soon have information about the toxicity of the compounds of interest in an aging model carried out in mice.

Reference market: Total innovation, Creation of new markets

Development stage: Feasibility

TRL: 4

Advantages: New product/process/service/technology

Patented technology: Yes

Country/ies: Italy

Technology validation/demonstration: Internal validation

Market positioning: Italian, European, International

Partner required: Enterprise, Seed capital, Cooperation in national /european / international project

Key words: virtual screening, Senolytic, Senescence, Aging, hit compounds

Url: *https://promott.cnr.it/en/technology/137/new-compounds-with-senolytic-activity*

UNIVERSAL PEPTIDE PROBES FOR THE MULTISCALE ISOLATION OF EXTRACELLULAR VESICLES

 # Record card: 138

Thematic areas

Health & Biotech
Health & Biotech / Smart Devices for Health and Wellness
Health & Biotech / Nanomedicine
Health & Biotech / Diagnostic, Medical imaging & advanced bioimaging
Health & Biotech / Regenerative Medicine
Health & Biotech / Care, Hygiene, Cosmetics
Health & Biotech / Biosensors
Health & Biotech / Micro and nanotechnology related to biological sciences
Health & Biotech / Bio-medicals
Health & Biotech / Diagnostic kits
Chemicals & Physics
Chemicals & Physics / Separation technologies

Description

We present a technology for the multiscale isolation (analytical-laboratory-production) of Extracellular Vesicles (VE), which overcomes the limitations of the currently available methods. As opposed to traditional "affinity-based" systems that exploit antibodies, our technology represents a radical paradigm shift in the development of affinity probes for vesicles, i.e. the use of peptides sensitive to the curvature of biological membranes (membrane sensing peptides - MSP-) for the specific and at the same time universal capture (not dependent on surface markers) of all small EVs (50-200nm). MSPs can be produced synthetically, in a scalable way and at low cost, and offer great versatility of integration on analytical supports or puri cation of different nature.

Type of innovation: Product innovation

Description of innovative features / Competitive advantages

Traditional affinity methods for the isolation of EVs are generally based on the use of antibodies to proteins present on their membrane. However, these markers are not uniformly expressed in the various subpopulations of EVs. As such, they allow a partial and not fully representative recovery of the EVs present in a sample. The technology based on MSPs proposed by us transcends this problem, being the affinity directed towards universal characteristics of the small vesicles (charge and membrane curvature). This determines a high yield and universally representative capture, as well as allowing the isolation of VE of plant and animal species indifferently. The synthetic aspects and prospective scale-up towards the isolation of VE on a large scale are also totally peculiar to these ligands, since antibodies have no application in this sector due to the high costs.

Reference market: Total innovation, Impacts on existing markets

Development stage: Feasibility

TRL: 4, 5

Advantages: New product/process/service/technology, Cost reduction

Patented technology: Yes

Country/ies: PCT

Technology validation/demonstration: Internal validation

Market positioning: Italian, European, International

Partner required: Enterprise, Seed capital, Cooperation in national /european / international project

Key words: Extracellular Vesicles, Peptides, Scale-up, Affin cationation

Url: *https://promott.cnr.it/en/technology/138/universal-peptide-probes-for-the-multiscale-isolationof-extracellular-vesicles*

SOFT RUBBER PROTEIN MODELS: A TOOL TO TEACH AND TO UNDERSTAND PROTEIN BIOLOGY

 # Record card: 139

Thematic areas

Health & Biotech
Health & Biotech / Bio-informatics
Tourism, social sciences and cultural heritage / Technologies for preservation of cultural heritage
Tourism, social sciences and cultural heritage / Education & learning
Tourism, social sciences and cultural heritage / Entertainment
Tourism, social sciences and cultural heritage / Socio-economic models
Tourism, social sciences and cultural heritage / Multimedia technologies

Description

The study of proteins is typically limited to notions, sometimes with the aid of virtual 3D models, obtained from visualization programs. A knowledge of this type, although useful, limits the ability to acquire a more direct knowledge, almost never leads to awareness of dimensions, and is particularly difficult for those who do not have a strong capacity for three-dimensional imagination.
To solve these difficulties, we propose the use of protein models made with soft material, to be explored individually, and to be assembled into multi-protein complexes by means of carefully embedded magnets.
The cases studied are: actin monomers, which can be assembled to form the lament, demonstrating the interactions between monomers and the properties of the lament; hemoglobin, made of 4 subunits (2 alpha and 2 beta); and the nucleosome complex: the proteins compose the histone octamer, around which the double strand of DNA (obtained with a simple tube) is wrapped, demonstrating the properties of the double helix, its winding and topological phenomena. The models are produced on the basis of rigorous scientific information, following the method described in Alderighi et al., In soft rubber, a material that makes it possible to obtain joints that are impossible with rigid models, and which conveys the idea of flexibility that actually characterizes living material, even at the nanometer scale.

Type of innovation: Product innovation

Description of innovative features / Competitive advantages

In the teaching of biology, in high schools and university courses, proteins are among the main subjects. However, they are not easy to understand, as they are invisible objects, whose characteristics are mainly described in a theoretical and / or schematic way.
The availability of tangible models, in flexible material, based on scientific data and easily manipulated, allows an understanding at a perceptual and experiential level impossible to reach in other ways.
So far the few attempts of physical modeling have been done using 3D printing in rigid plastic material, which fails to reflect many properties of biological molecules.
The possibility of producing the models in rubber has been demonstrated as a 'proof of principle' (see Alderighi et al, 2021. Computational design, fabrication and evaluation of rubber protein models), has proved feasible and has aroused interest with both teachers and students.
On a large scale, this possibility is currently unexplored.
The competitive advantage results from the fact of being the first (and only) to develop the idea, which has already been successfully tested on a small sample.

Reference market: Total innovation, Creation of new markets

Development stage: Prototype

TRL: 5, 6

Advantages: New product/process/service/technology, Cost reduction

Patentable technology: No

Patented technology: No

Publication of technology: Published

Technology validation/demonstration: Internal validation

Market positioning: Italian, European, International

Partner required: Enterprise, Public research center/university, Seed capital, Cooperation in national /european / international project

Key words: Models for teaching, Proteins, Biology, Science, Soft rubber

Url: *https://promott.cnr.it/en/technology/139/soft-rubber-protein-models-a-tool-to-teach-and-tounderstand-protein-biology*

PLASMA DEVICE FOR TREATING LIVING TISSUES

 # Record card: 140

Thematic areas

Health & Biotech
Health & Biotech / Bio-medicals
Health & Biotech / Care, Hygiene, Cosmetics
Health & Biotech / New therapies
Health & Biotech / Medical Device
Chemicals & Physics
Chemicals & Physics / Cold Plasmas

Description

The technology refers to an innovative plasma (ionized gas) source operating at atmospheric pressure and low electric power levels. A cold plasma is produced, characterized by an ion temperature significantly lower than the electron temperature. Partial ionization of a Helium flux is induced by a time-varying electric eld in between two parallel grids, both perpendicular to the flux itself. The plasma flux, mixing with ambient air, induces the formation of reactive chemical species (mainly Oxygen and Nitrogen radical species) capable of stimulating cellular reactions of interest for biomedical applications. Among them, disinfection of sensitive biological tissues (e.g., the cornea), with no effects on healthy cells viability, improved wound healing and tumor cells apoptosis.

Type of innovation: Product innovation

Description of innovative features / Competitive advantages

A variety of cold plasma sources has been developed by research groups all over the world for biomedical purposes. These sources exploit different schemes for the ionization of the working gas. The plasma is put in contact with the tissue to be treated and some electric current is induced to ow into the biological material. This kind of treatment is thus named “direct”. The cold plasma source here proposed is different from the other existing ones as an “indirect” treatment is performed, with no contact between the plasma and the biological sample and with electric currents fully confined inside the source itself. The effect on cell mechanisms is induced by the chemical species produced and carried by the neutral gas ow. This peculiarity allows to perform plasma treatment also on extremely sensitive surfaces, such as that of the cornea, which, otherwise, would be damaged by a direct treatment.

Reference market: Total innovation, Creation of new markets

Development stage: Prototype

TRL: 6

Advantages: New product/process/service/technology, Cost reduction

Patentable technology: Yes

Patented technology: Yes

Country/ies: Europe

Technology validation/demonstration: Internal validation

Market positioning: Italian, European, International

Partner required: Enterprise, Seed capital, Cooperation in national /european / international project

Key words: Cold plasma, Disinfection, Cornea, Wound healing, Apoptosis

Url: *https://promott.cnr.it/en/technology/140/plasma-device-for-treating-living-tissues*

SYSTEM AND PROCESS FOR AEROMAGNETIC GEOPHYSICAL PROSPECTING

 # Record card: 141

Thematic areas

Energy and environmental sustainability
Tourism, social sciences and cultural heritage / Safety and security
Energy and environmental sustainability / Sensory
Measurement tools and Standards
Tourism, social sciences and cultural heritage
Tourism, social sciences and cultural heritage / Archaeology
Energy and environmental sustainability / Safety and security

Description

The new technology relates to a system and a process for aeromagnetic geophysical prospecting. Geophysical prospecting is a non-destructive investigation technique of the subsoil which consists in measuring, using specific measuring instruments, some physical parameters of the soil that can reveal its structure, as well as the presence of buried objects. One geophysical prospecting technique is magnetometric prospecting. The magnetometric survey is applied in various areas: environmental monitoring (eg. Carrying out measurements that allow to detect the presence of pollutants and illegal landfills); archeology (e.g. identification of buried structures of archaeological interest); forensic eld (eg. identification of arms deposits or human burials); military context (e.g. identification of mine elds); civil eld; mining investigations; oil exploration; and geotechnics. We propose a system for aeromagnetic geophysical prospecting comprising a drone and two magnetometers preferably connected to the drone and spaced apart from each other.

Type of innovation: Product innovation

Description of innovative features / Competitive advantages

Various attempts have been made to solve the problem of providing a reliable and accurate aeromagnetic geophysical prospecting system. The problem presents obvious difficulties, due to the need to limit the number of additional components that contribute to increasing implementation costs and the complexity of using the system. The innovation consists in the miniaturization of the instrumentation. Compared to the existing one, the two micro-sensors are solidly connected to the drone and spaced from each other. It should be noted that, in this context, two elements are "solidly connected" when any translation or relative rotation between said elements is precluded.

It is understood that the two sensors can be solidly connected to the drone in a permanent way or they can be solidly connected to the drone in a removable way by means of removable connection means. All the instruments have a weight of about 300g. Furthermore, there are currently no applications of the portable magnetometric methodology in hostile environments such as those in which the presence of obstacles is strong (strong vegetation, walls, etc.). The new instrumentation makes it possible.

Reference market: Incremental innovation, Impacts on existing markets, Creation of new markets

Development stage: Prototype

TRL: 6, 7

Advantages: New product/process/service/technology, Cost reduction

Patented technology: Yes

Country/ies: Italy

Publication of technology: No

Technology validation/demonstration: External validation

Market positioning: Italian, European, International

Partner required: Enterprise, Cooperation in national /european / international project

Key words: Miniaturization, magnetic gradient, Drone, Cultural Heritage, Environment

Url: *https://promott.cnr.it/en/technology/141/system-and-process-for-aeromagnetic-geophysicalprospecting*

MONUMENTAL HERITAGE DIAGNOSTICS INSTRUMENTATION

 # Record card: 142

Thematic areas

Tourism, social sciences and cultural heritage

Tourism, social sciences and cultural heritage / Technologies for preservation of cultural heritage

Description

The instrumentation is based on the electrical resistivity tomography (ERT) which is a non-invasive geophysical technology used to obtain information on anomalous bodies possibly present in the subsoil. The theoretical basis lies in the different electrical properties of the lithotypes present in the subsoil. Starting from these considerations it is possible to shift the interest of applicability both on structures related to cultural heritage by creating a miniaturized portable instrumentation capable of being adapted both to situations in which highly resistive structures are analyzed (built heritage, frescoes, mosaics , etc.) and when analyzing structures with medium-low resistivity values (trees, wooden beams, structures buried in the marine environment, etc.). The instrumentation can also be adapted to the diagnostics of large infrastructures (bridges, tunnels, etc.).

Type of innovation: Product / process innovation in integration with an already existing technology

Description of innovative features / Competitive advantages

The instrumentation object of the invention involves the use of non-invasive electrodes that are made to adhere to the body to be investigated; a system that regulates the choice of current electrodes and potential electrodes; a system that regulates the injection of the current and the measurement of the potential difference; a computer with acquisition software and subsequent data processing. The instrument is equipped (innovative part) with an intelligent system capable of adjusting the output impedance and consequently adapting the contact resistance between the electrode and the material to be investigated. This allows the injection of current even in very resistive materials (frescoes, mosaics, masonry structures, statues, columns, etc.). A second system inserted in the instrumentation (innovative part) also allows to carry out measurements of spontaneous potential. This latter point is important in the study of the state of corrosion of the bars located in reinforced concrete structures (large infrastructures, bridges, tunnels, etc.). The possibility of increasing the number of electrodes allows the realization of 3D tomographies.

Reference market: Incremental innovation, Impacts on existing markets

Development stage: Prototype

TRL: 4

Advantages: Product/process/service/technology optimization

Patentable technology: Yes

Patented technology: No

Publication of technology: No

Technology validation/demonstration: External validation

Market positioning: Italian, European, International

Partner required: Enterprise, Public research center/university, Cooperation in national /european / international project

Key words: Electrical resistivity tomography, Non-invasive diagnosis, Miniaturization, Portability, Cultural Heritage

Url: h*ttps://promott.cnr.it/en/technology/142/monumental-heritage-diagnostics-instrumentation*

PORTABLE MICRO-SPATIALLY OFFSET RAMAN SPECTROMETER (P-MICRO-SORS)

 # Record card: 143

Thematic areas

Energy and environmental sustainability
Tourism, social sciences and cultural heritage
Tourism, social sciences and cultural heritage / Technologies for preservation of cultural heritage
Tourism, social sciences and cultural heritage / Archaeology
Tourism, social sciences and cultural heritage / Archeometry
Energy and environmental sustainability / Safety and security

Description

The instrument which is under development is a non-conventional portable Raman spectrometer. Raman spectrometers provide the molecular composition of the material surfaces, essential for their identification. The instrument peculiarity relies in the simultaneous acquisition of Raman spectra at imaged position and at different micrometric distances (offset) from the laser illumination area. Spectra acquired at the imaged position provide information about the molecular composition of the material surface, whereas in the spectra collected at offset distances there is a higher percentage of Raman photons coming from the inner portions. The micrometric spatial resolution of the instrument allows investigating in a non-invasive way and in-situ the compounds located below the surface at a depth range from a few tens to hundreds of micron.

Type of innovation: Product innovation

Description of innovative features / Competitive advantages

The instrument has never been developed neither by Research Institutions nor by companies. A portable instrument optimized at the millimetric scale (SORS) is developed by Agilent for pharmaceutical and security applications; however, the under development instrument differs for the micrometric scale range of investigation (*micro-SORS*); the extension of the technique to the micrometric range needs the development of a deeply different technology if compared with that used for portable SORS and the applicability to elds not already explored by conventional SORS. In the non-invasive instruments scenario, the instrument is unique since it is able to provide the molecular composition of the compounds located below the surface, not only their optical properties or elemental composition, thus allowing a unequivocal identification of the target compounds.

Reference market: Total innovation, Impacts on existing markets

Development stage: Feasibility

TRL: 3

Advantages: New product/process/service/technology

Patentable technology: Yes

Patented technology: No

Publication of technology: No

Technology validation/demonstration: Internal validation

Market positioning: Italian, European, International

Partner required: Enterprise, Public research center/university, Cooperation in national /european / international project

Key words: Raman spectroscopy, Micro-spatially offset raman spectroscopy, Non-invasive, Portable, Cultural Heritage

Url: *https://promott.cnr.it/en/technology/143/portable-micro-spatially-offset-raman-spectrometerp-micro-sors*

MEMTEK: NEXT GENERATION MEMBRANES FOR WATER TREATMENT APPLICATIONS

 # Record card: 144

Thematic areas

Energy and environmental sustainability

Energy and environmental sustainability / Environmental engineering/technologies

Energy and environmental sustainability / Pollution treatment (air, soil, water)

Chemicals & Physics

Chemicals & Physics / Separation technologies

Agrifood

Agrifood / Agriculture

Agrifood / Food quality & safety

Description

WembraneX is an Italian start-up born with the ambition to make a significant contribution to UN Sustainable Goal 6 - Ensure Access to Clean Water and Sanitation for all by 2030.

Our technology allows a significant improvement in the performance of MBR based municipal and industrial water treatment facilities by decreasing their operating costs up to 50%. We achieve this goal through a new generation of membranes, which are easily retrofittable in existing facilities without additional capital investment. Specifically, the MEMTEK membrane manufactured by WembraneX has intrinsic anti-fouling and anti-microbial properties, is tailorable depending on the characteristics of the waters to be puri ed, has stable performance over time and is manufactured using environmentally friendly materials.

Type of innovation: Product innovation

Description of innovative features / Competitive advantages

MEMTEK membranes in MBR based water treatment facilities provide several advantages compared to commercially available membranes and specifically:

- ✓ Low fouling tendency;
- ✓ High antimicrobial activity;
- ✓ Properties tuneable to target application;
- ✓ High stability;
- ✓ Low environmental impact of the materials used in the manufacturing process.

Based on an analysis to assess the operating costs improvements in a water treatment facility over 12 years, the use of a new MEMTEK membrane is expected to deliver a reduction of:

- ✓ up to 75% in the use of chemicals for membrane modules cleaning;
- ✓ up to 75% in the time spent for module cleaning;
- ✓ up to 30% in membrane module replacement;

this will translate in an estimated overall operating cost reduction up to 50% in a MBR-based facility.

Reference market: Incremental innovation, Impacts on existing markets, Creation of new markets

Development stage: Prototype

TRL: 5, 6

Advantages: New product/process/service/technology, Cost reduction

Patented technology: Yes

Country/ies: Italy, UK, Germany, France, Belgium e Holland

Technology validation/demonstration: External validation

Market positioning: Italian, European, International

Partner required: Enterprise, Seed capital, Cooperation in national /european / international project

Key words: Membrane, Water treatment, Fouling, Sustainability, Circular economy

Url: *https://promott.cnr.it/en/technology/144/memtek-next-generation-membranes-for-watertreatment-applications*

AGEING DETERMINATION OF BALSAMIC AND TRADITIONAL BALSAMIC VINEGAR OF MODENA

 # Record card: 145

Thematic areas

Agrifood

Agrifood / Food quality & safety

Description

Ageing characterization of Balsamic Vinegar of Modena (BVM) and Traditional Balsamic Vinegar of Modena (TBVM) by the combined use of Nuclear Magnetic Resonance spectroscopy (NMR) and multivariate statistical analysis. Our database allows to differentiate BVM from TBVM samples. Moreover, within BVMs, samples with ageing <3/>3 years can be discriminated and within TBVM, samples with ageing between 12 and 25 years as well as >25 years can be discriminated. The use of ^{13}C-NMR spectroscopy, allows to check whether TBVM samples are produced according to the set rules (authenticity assessment) or if they are defrauded.

Type of innovation: Service/know how innovation

Description of innovative features / Competitive advantages

The proposed method allows the differentiation between Balsamic Vinegar of Modena (PGI) and Traditional Balsamic Vinegar of Modena (PDO), being this latter a much more valuable vinegar. Currently, PDO certification is evaluated only by using sensory analysis and basic chemical investigations (acidity, density, dry residue etc). The advantage of using NMR spectroscopy respect to other analytical techniques is the high reproducibility, no sample derivatization and moreover it is a nondestructive technique. The proposed method allows to establish the authenticity of the high valuable TBVM, representing a great analytical tool for both producers and consumer's protection.

Reference market: Impacts on existing markets

Development stage: Prototype

TRL: 8

Advantages: Product/process/service/technology optimization

Patentable technology: No

Patented technology: No

Publication of technology: Published

Technology validation/demonstration: External validation

Market positioning: Italian, European, International

Partner required: Enterprise, Public research center/university, Private research center, Cooperation in national /european / international project

Key words: Balsamic vinegar of Modena, NMR, Aging, Authenticity

Url: *https://promott.cnr.it/en/technology/145/ageing-determination-of-balsamic-and-traditionalbalsamic-vinegar-of-modena*

HONEY AUTHENTICITY DETERMINATION

 # Record card: 146

Thematic areas

Agrifood

Agrifood / Food quality & safety

Description

Characterization of authenticity of honey by the combined use of high resolution Nuclear Magnetic Resonance spectroscopy (NMR) and multivariate statistical analysis. Particularly, based on our database, different characterization involving authentication assessment, like botanical or geographical origin determination are possible. Moreover, it is possible to detect saccharides addictions like inulin, corn/malt syrups, and inverted sugar. Finally, it is possible to distinguish the Italian biological honey from the conventional one.

Type of innovation: Service/know how innovation

Description of innovative features / Competitive advantages

The use of NMR spectroscopy allows the detection of several classes of chemical compounds simultaneously (metabolites). In case of honey, it is possible to monitor both all metabolite pro le and the saccharide composition. The combined use of NMR spectroscopy and multivariate statistical analysis allows the evaluation of different aspect of honey authenticity. The possibility to apply an advanced analytical technique to differentiate organic/conventional honey samples is a further innovative advantage. Our database is continuously incremented and updated.

Reference market: Impacts on existing markets

Development stage: Prototype

TRL: 8

Advantages: Product/process/service/technology optimization

Patentable technology: No

Patented technology: No

Publication of technology: Published

Technology validation/demonstration: External validation

Market positioning: Italian, European, International

Partner required: Enterprise, Public research center/university, Private research center, Cooperation in national /european / international project

Key words: Honey, NMR, Botanical origin, Geographical origin, Saccharide addiction

Url: *https://promott.cnr.it/en/technology/146/honey-authenticity-determination*

AUTHENTICITY AND RIPENING DETERMINATION OF PDO PARMIGIANO REGGIANO CHEESE

 # Record card: 147

Thematic areas

Agrifood

Agrifood / Food quality & safety

Description

Combined use of High-Resolution Nuclear Magnetic Resonance spectroscopy (NMR) and multivariate statistical analysis for the differentiation of PDO Parmigiano Reggiano samples according to ripening and for the differentiation of PDO Parmigiano Reggiano from “Grana type” products available on the market.

Type of innovation: Service/know how innovation

Description of innovative features / Competitive advantages

The proposed method allows to monitor different classes of chemical compounds simultaneously, within a single experiment. The pro ling of these compounds (metabolites) is different according to the ripening of Parmigiano Reggiano PDO, representing a sort of fingerprint. Moreover, being Parmigiano Reggiano a PDO product, it has to be produced following the disciplinary indications. These latter determine a particular metabolic pro le that can be used to differentiate PDO samples from “Grana type” or “Parmesan like” cheeses present on the market. Therefore, the proposed method represents a valid analytical tool to guarantee the authenticity for the Parmigiano Reggiano PDO chain.

Reference market: Impacts on existing markets

Development stage: Prototype

TRL: 8

Advantages: Product/process/service/technology optimization

Patentable technology: No

Patented technology: No

Publication of technology: Published

Technology validation/demonstration: External validation

Market positioning: Italian, European, International

Partner required: Enterprise, Public research center/university, Private research center, Cooperation in national /european / international project

Key words: Parmigiano Reggiano PDO, NMR, Ripening, Authenticity, Grana type

Url: *https://promott.cnr.it/en/technology/147/authenticity-and-ripening-determination-of-pdoparmigiano-reggiano-cheese*

QUALITY AND AUTHENTICITY OF SAFFRON (CROCUS SATIVUS L.)

 # Record card: 148

Thematic areas

Agrifood

Agrifood / Food quality & safety

Description

High-Resolution Nuclear Magnetic Resonace (NMR) in solution also combined with multivariate statistical analysis to determine the quality and authenticity of saffron. Particularly the content of components (metabolites) is evaluated. The analysis allows to detect frauds with synthetic colorants (Sudan I-IV, tratrazine, sunset yellow) or bioadulterants (*Gardenia jasminoides* fruit extracts, *Crocus sativus* stamens, turmeric, safflower), to evaluate the freshness of saffron, to differentiate the Italian PDO saffron from commercial ones, as well as to differentiate the geographical origin of saffron samples harvested in the same year.

Type of innovation: Service/know how innovation

Description of innovative features / Competitive advantages

The proposed method allows to monitor different classes of chemical compounds within a single experiment, obtaining a metabolic pro le of saffron extracts analyzed. This allows to monitor within a single experiment the presence of different adulterants or bioadulterants. Moreover, our database includes several saffron samples from different geographical origins and stored from 0 to 14 years, that allows to evaluate the freshness of saffron regardless its provenance.

Reference market: Impacts on existing markets

Development stage: Prototype

TRL: 8

Advantages: Product/process/service/technology optimization

Patentable technology: No

Patented technology: No

Publication of technology: Published

Technology validation/demonstration: External validation

Market positioning: Italian, European, International

Partner required: Enterprise, Public research center/university, Private research center, Cooperation in national /european / international project

Key words: Saffron, NMR, Authenticity, Synthetic colorants, Bioadulterants

Url: *https://promott.cnr.it/en/technology/148/quality-and-authenticity-of-saffron-crocus-sativus-l*

ANALYTICAL METHOD FOR THE DETERMINATION OF ARABICA/ROBUSTA COMPOSITION IN ROASTED COFFEE BLENDS

 # Record card: 149

Thematic areas

Agrifood

Agrifood / Food quality & safety

Agrifood / Nutrition & health

Description

Direct quantification of the percentage of arabica in roasted and ground coffee blends of arabica/robusta by High Resolution Nuclear Magnetic Resonance spectroscopy (NMR), in solution and multivariate statistical analysis. Particularly, the metabolites content present in water extracts of coffee is analyzed and compared with NMR data of our database. This latter includes data concerning several roasted and ground arabica/robusta coffee blends from different geographical origin and with different roasting degrees, with arabica composition ranging between 0 and 100% in weight. A statistical regression protocol performed on NMR data allows to predict the percentage of arabica in roasted and ground coffee blends of unknown composition.

Type of innovation: Service/know how innovation

Description of innovative features / Competitive advantages

The proposed method allows to monitor different classes of chemical compounds within a single experiment, obtaining a metabolic pro le of the roasted coffee blends analyzed. This represents an advantage in the prediction of the percentage of arabica compared to chromatographic techniques that evaluate the arabica/robusta composition by monitoring single compounds such as 16-Omethylcafestol (present in robusta in variable amount based on the geographical origin and in a small amount in arabica) or D-5-avenasterol (present in both arabica and robusta but in a larger amount in the latter) which could be added or subtracted. Furthermore, our database including coffee blends of different geographical origins and different roasting degrees, presents a natural heterogeneity that mediates metabolic differences attributable to both provenance and roasting conditions of coffee.

Reference market: Incremental innovation, Impacts on existing markets

Development stage: Industrialization

TRL: 8, 9

Advantages: New product/process/service/technology

Patented technology: Yes

Country/ies: Italy

Technology validation/demonstration: External validation

Market positioning: Italian, European, International

Partner required: Enterprise, Cooperation in national /european / international project

Key words: Roasted coffee blends, Arabica, Robusta, NMR, Composition

Url: *https://promott.cnr.it/en/technology/149/analytical-method-for-the-determination-ofarabicarobusta-composition-in-roasted*

DYNAMIC IN-SILICO DOCKING FOR THE DRUG DISCOVERY

 # Record card: 150

Thematic areas

Health & Biotech

Health & Biotech / Development of new drugs

Health & Biotech / Bio-medicals

Health & Biotech / Bio-informatics

Description

The virtual dynamic docking, carried out in the MOLBD3 lab of the Institute of Biophysics, allows the identification of new drugs through the structural information deriving from the study of target proteins, responsible for some human pathologies. In particular, we screen drugs or small molecules (commercial/own libraries) against known protein sites, surface cavities, surfaces of protein-protein interactions (**fixed/rigid hotspots**) or structural transition states (d**ynamic hotspots)**. The identification of hotspots takes place through structural analysis and molecular dynamics simulations. High throughput (HT) approaches have great potential as they are based on high computational capacity. In this context, our skills **supervise the calculation methods** and support the interpretation of the large amount of HT data, **directing the research in a more focused way**. This approach allows to map in detail the configurations of the target protein regions, significantly expanding the possibilities of identifying effective drugs.

Type of innovation: Service/know how innovation

Description of innovative features / Competitive advantages

The innovative aspect lies in the study of the dynamics of proteins related to their functions. Not only the average structure of a protein (obtained through different experimental methods) but also transient sites and cavities, such as those involving intermediate folding states or conformational transitions identifiable by molecular dynamics, are considered as target surfaces. Since intermediate folds only exist for a short time, they can be difficult to study experimentally. Through advanced algorithms and computational simulations, it is possible to model the folding trajectory of a protein, thus identifying transient forms that could bind to new drugs with high affinity and specificity. In a biological context with single molecule resolution, copies of the same protein are fewer and immersed in a complex context of different macromolecules. In this condition, transient states could play a much more important role than hypothesized. This approach provides the ability to **transform proteins** that may be difficult to pharmacologically target with ordinary methods, **into drug targets.**

Reference market: Incremental innovation, Impacts on existing markets

Development stage: Industrialization

TRL: 8, 9

Advantages: New product/process/service/technology, Product/process/service/technology optimization, Cost reduction

Patentable technology: No

Patented technology: No

Publication of technology: No

Technology validation/demonstration: External validation

Market positioning: Italian, European, International

Partner required: Enterprise, Public research center/university, Private research center, Seed capital, Cooperation in national /european / international project

Key words: Molecular dynamics, Virtual docking, Transitional states, high-throughput, High performance computing

Url: *https://promott.cnr.it/en/technology/150/dynamic-in-silico-docking-for-the-drug-discovery*

GEOGRAPHICAL ORIGIN OF CONCENTRATED TOMATO PASTE

 # Record card: 151

Thematic areas

Agrifood

Agrifood / Nutrition & health

Agrifood / Food quality & safety

Description

Combined use of High-Resolution Nuclear Magnetic Resonance (NMR) spectroscopy in solution and multivariate statistical analysis for the geographical differentiation of Italian and Chinese concentrated tomato paste. Particularly the metabolites content of acqueos exctrats of concentrated tomato paste is evaluated. The obtained data are included in a classification statistical model performed on NMR data related to more than 100 double and triple Italian and Chinese concentrated tomato paste samples belonging to two production years (2007 and 2008) representing our database. This latter allows to classify the analyzed sample according to its provenance regardless of the production year and concentration rate.

Type of innovation: Service/know how innovation

Description of innovative features / Competitive advantages

The methodology allows to monitor different classes of chemical compounds within a single experiment; the whole of these compounds (metabolites) reflects the pedoclimatic conditions in which tomato plant is harvest giving information relating to its provenance. Actually the variation of the metabolites content cannot be attributed neither to tomato ripening stage, nor to the used cultivars, nor to the processing since both in Italy and China, tomatoes with different ripening stages, 15/20 cultivars and the same processing procedures are used. Moreover, the proposed methodology, investigates lyophilized samples; this represents an advantage versus isotopic techniques that monitor isotopes also present in water, which could introduce errors. Finally, the database includes more than 100 Italian and Chinese double and triple concentrated tomato paste samples belonging to two production years.

Reference market: Incremental innovation, Impacts on existing markets

Development stage: Industrialization

TRL: 8

Advantages: New product/process/service/technology

Patentable technology: No

Patented technology: No

Publication of technology: Published

Technology validation/demonstration: External validation

Market positioning: Italian, European, International

Partner required: Enterprise, Cooperation in national /european / international project

Key words: Concentrated tomato paste, Geographical origin, NMR, Metabolites

Url: *https://promott.cnr.it/en/technology/151/geographical-origin-of-concentrated-tomato-paste*

SELF: NON-INVASIVE SYSTEM FOR FETAL ELECTROCARDIOGRAM EXTRACTION AND FETAL AUTONOMIC NERVOUS SYSTEM CHARACTERIZATION

 # Record card: 152

Thematic areas

Health & Biotech

Health & Biotech / Bio-medicals

Health & Biotech / Smart Devices for Health and Wellness

Health & Biotech / Diagnostic, Medical imaging & advanced bioimaging

Description

The proposed system is based on a high-resolution electrocardiograph in which the electrodes are positioned on maternal abdomen. The acquired signals are processed using a completely unsupervised software for fetal ECG extraction based on independent component analysis, maternal ECG canceling and a quality index optimization. The electrocardiograph is constituted by a light-weight and light-dimension portable unit, which acquires the signals and transmit them to a computer where the analysis software runs. The software can also extract heart rate variability features, which provide information about fetal autonomic nervous system maturation. The system allows to accurately extract fetal ECG since the second trimester of pregnancy even in critical conditions like noise presence and uterine contractions.

Type of innovation: Product / process innovation in integration with an already existing technology

Description of innovative features / Competitive advantages

The system is innovative since relays on a novel method for fetal ECG extraction that is based on the optimization of a quality index of fetal ECG designed considering the pseudo-periodicity of the signal. Such method is integrated with more traditional approaches for fetal ECG extraction: maternal cancelling and independent component analysis. Moreover, the method does not relay on preliminary assumptions regarding QRS complex periodicity and shape, thus it is able to detect also aberrant QRS complexes or arrythmias. The procedure, completely unsupervised, can be applied both in clinics and for self-monitoring of fetal health during pregnancy. Heart rate variability features extraction, both in time and frequency domain, allows the characterization of fetal autonomic nervous system maturation. The gold-standard for this type of assessment is magnetocardiography, which has a high cost and is not mobile.

Reference market: Incremental innovation

Development stage: Prototype

TRL: 4

Advantages: New product/process/service/technology, Product/process/service/technology optimization

Patentable technology: Yes

Patented technology: No

Technology validation/demonstration: External validation

Market positioning: Italian, European, International

Partner required: Enterprise, Private research center, Cooperation in national /european / international project

Key words: Fetal electrocardiography, Non-invasive devices, Self-monitoring, Autonomic nervous system, Automatic analysis

Url: *https://promott.cnr.it/en/technology/152/self-non-invasive-system-for-fetal-electrocardiogramextraction-and-fetal-autonomic*

SCREENING PLATFORM TO MONITOR THE BIOLOGICAL EFFECTS OF COMPOUNDS, NUTRIENTS AND DRUGS ON CELL METABOLISM AND HEALTH USING UORESCENT AND BIOLUMINESCENT IMAGING SYSTEMS AND MEASUREMENTS OF RELEVANT PHYSIOLOGICAL PARAMETERS ON A MEDIUM-TO-LARGE SCALE

 # Record card: 153

Thematic areas

Health & Biotech - Health & Biotech / Micro and nanotechnology related to biological sciences
Health & Biotech / Bio-medicals - Health & Biotech / New therapies
Health & Biotech / Diagnostic, Medical imaging & advanced bioimaging
Health & Biotech / Development of new drugs - Health & Biotech / Biosensors
Agrifood - Agrifood / Nutrition & health
Agrifood / Food quality & safety

Description

To the enterprises working in the eld of nutrition/nutraceutics and drug development/repositioning, we offer the know-how and state-of-the-art instrumentation of our labs to monitor multiple relevant biological parameters at the cellular level: metabolic activity, vitality, health, but also stress and toxicity. The use of advanced imaging techniques based on
Fluorescent/bioluminescent probes together with the availability of time-lapse acquisitions,
guarantee the cutting-edge analysis of different biological parameters over time. This is indeed fundamental for the comprehension of the action that new molecules and treatments may exert on men and animals. The implementation of tissue-specific and disease-model cellular systems further extends the study of those effects on specific contexts (nutrition-related, therapeutic or tissue-specific) providing valuable pre-clinical data and scientific validation of the biologic action of the products, before they are put on the market.

Type of innovation: Service/know how innovation

Description of innovative features / Competitive advantages

The understanding of cellular responses to specific molecules/drugs/treatments is crucial to optimize their biological action, to validate their therapeutic effect, or to identify novel nutritional supplements and bioactive compounds, ahead of their distribution on the market. The implementation of cutting-edge biomedical investigations and different cellular models represents an essential innovative approach for the development of new therapies/treatments/diets aimed to satisfy the present clinical and commercial requests, including those focusing on a “personalized” care. The possibility to perform middle-to-large scale studies definitively widen the eld of action of our approach, ensuring the reliability and reproducibility of the results. This approach guarantees to identify/characterize/validate the biologically relevant products with a high degree of confidence, reducing the pre-clinical testing time and facilitating therapeutic effectiveness and success on the market.

Reference market: Impacts on existing markets
Development stage: Prototype
TRL: 6, 7, 8
Advantages: Product/process/service/technology optimization
Patentable technology: No
Patented technology: No
Publication of technology: Published
Technology validation/demonstration: Internal validation
Market positioning: Italian, European, International
Partner required: Enterprise, Private research center, Cooperation in national /european / international project
Key words: Biomolecule testing, Cell metabolism and health, Drug development validation, Nutriceutics, Cellular imaging
Url: *https://promott.cnr.it/en/technology/153/screening-platform-to-monitor-the-biological-effectsof-compounds-nutrients-and*

A SUSTAINABLE BIOPROCESS FOR THE VALORIZATION OF BIO-WASTE AND CO2 INTO "GREEN HYDROGEN" AND "L-LACTIC ACID" AT HIGH YIELDS

 # Record card: 154

Thematic areas

Chemicals & Physics
Chemicals & Physics / Sustainable substances and green chemistry
Energy and environmental sustainability
Energy and environmental sustainability / Waste management
Energy and environmental sustainability / Renewable sources
Energy and environmental sustainability / Energy production, transmission and conversion Bioeconomy

Description

The technology, developed by CNR-ICB, is based on an innovative bioprocess called "Caphnophilic (CO2-requiring) Lactic Fermentation (CLF)", developed in the hyperthermophilic bacterium Thermotoga neapolitana (EP patent: EP2948556B1), which allows the production of "green" hydrogen and capture and valorization of CO2 in L -lactic acid (98% e.e.). The microbial platform offers general robustness, excellent reproducibility, high bio-hydrogen yields, good versatility in substrates that can be fermented, as well as a low risk of contamination due to hyper thermophilic conditions. It is also possible to feed the process not only with monosaccharides, but also with polysaccharides-based complex matrices, and therefore can be used for the valorization of vegetable waste and by-products of the agri-food industry without any hydrolytic pretreatment, rich for example in starch, sucrose, lactose, well integrated into the concept of circular economy.

Type of innovation: Process innovation

Description of innovative features / Competitive advantages

The sustainable microbial platform developed by ICB-CNR is a "CO2 neutral" system for the biological production of green hydrogen and L-lactic acid at high yields, entirely based on renewable sources, which adopts a circular approach based on the recovery and recycling of byproducts and waste. The current scale is a 3L laboratory prototype, producing 2L/L culture of H2 and 2g/L culture of L-lactic acid, in 24 hours. It would be necessary to scale the technology in an industrially relevant environment, to evaluate the economic feasibility of the process. At the plant level, low-cost bioreactors already used and validated in multiple fermentation processes would be exploited. To heat the bioreactors to 80 ° C, industrial thermal waste would be recovered by means of heat exchangers. Furthermore, thanks to the ability of Thermotoga cells to internalize and metabolize complex sugars, waste can be used without any hydrolytic treatment, overcoming what is often defined as the bottleneck in waste valorisation processes due to low sustainability and high costs of acid and/or base and/or enzymatic treatments.

Reference market: Incremental innovation, Impacts on existing markets, Creation of new markets
Development stage: Prototype
TRL: 4, 5
Advantages: New product/process/service/technology, Cost reduction
Patented technology: Yes
Country/ies: Italy, Europe

Publication of technology: Published
Technology validation/demonstration: External validation
Market positioning: Italian, European
Partner required: Enterprise, Seed capital, Cooperation in national /european / international project
Key words: Green hydrogen, L-lactici acid, By-products and bio-waste valorization, Circular economy, Decarbonization
Url: *https://promott.cnr.it/en/technology/154/a-sustainable-bioprocess-for-the-valorization-of-biowaste-and-co2-into-green*

SCREENING PLATFORM FOR THE DEVELOPMENT OF NEW 'LEAD COMPOUNDS'

 # Record card: 155

Thematic areas

Health & Biotech
Health & Biotech / New therapies
Health & Biotech / Development of new drugs
Chemicals & Physics
Chemicals & Physics / Organic substances
Chemicals & Physics / Separation technologies

Description

The development of an innovative screening platform of natural marine extracts guided by biological assays represents one of the main products developed within the Antitumor Drugs and Vaccines from the SEA (ADViSE) project which aims to provide a new vision in Drug Discovery processes. This platform aims at the rapid and efficient identification of natural molecules useful as pharmaceutical leads for the ght against oncological diseases with the aim of developing new immunotherapies, immunomodulators and chemotherapeutic agents, chemo-preventive agents and adjuvants for therapeutic cancer vaccines. The screening platform was born and contextualized in the studies on the ability of small organic molecules to transmit a specific immune response against tumor cells. This technology is based on the direct effect of the compounds both on neoplastic cells and on cells responsible for the recognition of harmful substances or alterations of self-components in neoplastic diseases, evaluating the ability to direct the quality and type of the immune response to prevent and/or stop the progression of the disease.

Type of innovation: Service/know how innovation

Description of innovative features / Competitive advantages

One of the main characteristics and advantages of this technology lies in the rapidity of analysis and fractionation which allows to obtain classes of natural compounds as new 'lead compounds' and in the possibility to combine antitumor tests with immunomodulation assays on dendritic cells, main responsible for triggering and modulation of immune response. In addition, the development of this innovative Drug Discovery Platform, in the context of the fight against oncological diseases, also intends to enhance an existing system of research skills, innovation and industrial know-how in the area of specialization of Biotechnology and Human Health. Therefore, from a technological and industrial point of view, this Platform aims to implement a translational model for the enhancement and transfer to the pharmaceutical industry of the results of basic and pre-clinical research in Drug Discovery processes on immunotherapeutic agents and components of anticancer vaccines, in order to favor short-medium term economic-social growth objectives in priority areas of innovation such as innovative therapeutic approaches or the development of new pharmacologically active molecules and new drugs.

Reference market: Incremental innovation

Development stage: Feasibility

TRL: 4

Advantages: Product/process/service/technology optimization, Cost reduction

Patentable technology: Yes

Patented technology: No

Technology validation/demonstration: Internal validation

Market positioning: Italian, European, International

Partner required: Enterprise, Cooperation in national /european / international project

Key words: Drug discovery, Marine products, Immunomodulators, Anticancer products, Fractionation platform

Url: *https://promott.cnr.it/en/technology/155/screening-platform-for-the-development-of-new-leadcompounds*

VOLIS - ONLINE ASSESSMENT OF ITALIAN SIGN LANGUAGE

 # Record card: 156

Thematic areas

ICT & Electronics

ICT & Electronics / Multimedia

Health & Biotech

Health & Biotech / Smart Devices for Health and Wellness

Tourism, social sciences and cultural heritage

Tourism, social sciences and cultural heritage / Education & learning

Description

VOLIS is an online platform that contains various tests for assessing Italian Sign Language (LIS) comprehension skills in signing children, from 4 to 11 years of age. The consequences of some difficulties such as deafness, cognitive impairments and autism spectrum disorder may affect learning, social interaction and broad communicative skills. The use of LIS may support children that have difficulties in acquiring and using a using spoken languages. In order to detect and overcome possible barriers in Sign Language acquisition, it is necessary to have reliable tools for the evaluation of educational and rehabilitative programs in which a sign language is used, in order to develop effective speech therapy programs and didactic proposals. Some tests can also be used to verify LIS skills of hearing adults who attend courses to learn LIS.

Type of innovation: Service/know how innovation

Description of innovative features / Competitive advantages

It is estimated that there may be at least 300 different Sign Languages around the world, but the research and study of Sign Languages and their users is still relatively new (compared to vocal languages, that is), as it started around 1960. Furthermore, along with the 80% of all spoken languages in the whole world, none of these Sign Languages has yet its own writing system. As of today, there's still a scarcity of linguistic assessment tools that are specific for and/or tailored to Sign Languages. Some of the innovative features of this platform are its complete online presence/availability and the use of evaluation tools that have not been translated or adapted from other languages but have been specifically developed for LIS users and LIS assessment.

Reference market: Incremental innovation, Impacts on existing markets, Creation of new markets

Development stage: Prototype

TRL: 7, 8

Advantages: New product/process/service/technology, Cost reduction

Patented technology: No

Technology validation/demonstration: External validation

Market positioning: Italian, European, International

Partner required: Enterprise, Public research center/university, Seed capital, Cooperation in national /european / international project

Key words: Assessment, Comprehension, Online LIS, Sign language

Url: *https://promott.cnr.it/en/technology/156/volis-online-assessment-of-italian-sign-language*

PLANAR ANTENNA FOR EFFICIENT REDIRECTION AND COLLECTION IN FLUORESCENCE DIAGNOSTICS

 # Record card: 157

Thematic areas

ICT & Electronics
ICT & Electronics / Sensor/multi-sensor technology, instrumentation
Chemicals & Physics
Chemicals & Physics / Micro and nanotechnology related to physical, chemical and exact sciences Chemicals & Physics / Quantum optics
Chemicals & Physics / Radiometry, photometry and vision
Chemicals & Physics / Atomic and molecular spectroscopy
Agrifood - Agrifood / Nutrition & health - Agrifood / Food quality & safety
Automotive transport and logistics - Health & Biotech
Health & Biotech / Biosensors - Health & Biotech / Diagnostic kits
Energy and environmental sustainability - Energy and environmental sustainability / Sensory

Description

The technology concerns planar optical antennas composed of thin metal films and dielectric materials for the efficient direction of the light emitted by light sources, such as fluorescent molecules and bio-markers. They consist of a reflector layer, adjacent to the substrate, and a director, semi-reflective, between which the emitter is positioned, integrated into a homogeneous dielectric layer. By respecting the rules for the distance between the layers and the emitter, it is possible to direct light in the upper plane within small angles with great advantage for collection both with traditional and fiber optics. The technology is scalable so it adapts to signals in different spectral ranges from visible to TeraHertz and over a large surface. The antenna can be manufactured with different methods, simple and flexible, for the deposition of thin films. It finds direct application in in-vitro fluorescence diagnostics, sensors and bio-imaging techniques. It also allows the creation of brighter, directional and potentially cheaper light sources and more efficient and directional detectors, with great impact in the elds of information technology, automotive and quantum technologies.

Type of innovation: Product innovation

Description of innovative features / Competitive advantages

The technology makes it possible to create high-efficiency optical antennas through a planar configuration, extremely advantageous in terms of costs, simplicity of manufacture, spectral flexibility and emitter positioning. The efficient direction of light in very small angles allows to
collect and measure even very weak light signals, at the level of individual fluorescent molecules. The measurement can be performed with simple optical instruments, directly coupling the directed emission to an optical fiber without the aid of additional lenses and objectives, and with a single-mode fiber coupling efficiency that can exceed 50%. These advantages make the technology flexible, scalable and suitable for different types of applications for the optimization and simplification of light signal collection systems.

Reference market: Incremental innovation, Impacts on existing markets

Development stage: Prototype

TRL: 4

Advantages: New product/process/service/technology

Patentable technology: Yes

Patented technology: Yes

Country/ies: Italy, PCT, Europe

Technology validation/demonstration: Internal validation

Market positioning: Italian, European, International

Partner required: Enterprise, Private research center

Key words: Planar optical antenna, Light emitters, Optical sensors, Bio-sensing, Fluorescences diagnostics

Url: *https://promott.cnr.it/en/technology/157/planar-antenna-for-e cient-redirection-andcollection-in-uorescence-diagnostics*

NUCLEAR MAGNETIC RESONANCE SPECTROSCOPY FOR SOLID OR "SOFT" MATERIALS AND SYSTEMS

 # Record card: 158

Thematic areas

ICT & Electronics- ICT & Electronics / Optoacustic sensors, Optoelectronic devices - ICT & Electronics / Nanotechnologies related to electronics and microelectronics - Additive and advanced industrial manufacturing - Additive and advanced industrial manufacturing / Packaging - Additive and advanced industrial manufacturing / Additive manufacturing processes and materials Additive and advanced industrial manufacturing / Factory of the Future Materials - Materials / Wood products Health & Biotech - Health & Biotech / Nanomedicine - Health & Biotech / Diagnostic, Medical imaging & advanced bioimaging - Health & Biotech / Development of new drugs - Health & Biotech / Regenerative Medicine - Health & Biotech / Care, Hygiene, Cosmetics- Tourism, social sciences and cultural heritage - Tourism, social sciences and cultural heritage / Technologies for preservation of cultural heritage - Aerospace and Earth Science - Aerospace and Earth Science / Aeronautical technologies and avionics - Tourism, social sciences and cultural heritage / Multimedia technologies Tourism, social sciences and cultural heritage / Archaeology - Agrifood - Agrifood / Agriculture - Agrifood / Food quality & safety - Automotive transport and logistics - Automotive transport and logistics / Vehicles - Automotive transport and logistics / Shipbuilding - Automotive transport and logistics / Innovative fuels - Chemicals & Physics - Energy and environmental sustainability

Description

Solid State Nuclear Magnetic Resonance spectroscopy (SSNMR) is today one of the most powerful techniques for characterizing solid and soft materials and systems. This spectroscopy allows the detailed characterization of structural and dynamic properties over large spatial (0.1-100 nm) and time (10^{2}-10^{-11} s) scales. Accessing these properties allows a deep knowledge of a material to be obtained and its design and optimization to be oriented. The "probes" used in SSNMR are the nuclei of the chemical elements naturally present in the analyzed systems, distributed along the Periodic Table. Examples of relevant properties/processes that can be determined by SSNMR are: chemical and supramolecular structure, interactions between atoms and molecules, degree of mixing and interactions between the different components, phase properties and polymorphism, amorphous phases, transformations, hydration, degradation, molecular motions.

Type of innovation: Service/know how innovation

Description of innovative features / Competitive advantages

SSNMR combines great power with extraordinary versatility. It allows the analysis of almost every type of solid or semi-solid, crystalline, amorphous or semi-crystalline, organic, inorganic or hybrid material / system, directly in its state of use (powders, films, fibers, ...), without any pre-treatment. The possibility of observing chemical elements naturally present in the sample and a very large "library" of experiments allow the characterization of even very complex materials. Examples of sectors of successful application are pharmaceutics, biomedicine, energy transition, circular economy, construction, technology, catalysis. SSNMR requires dedicated, complex and expensive instrumentation and highly specialized know-how. Our group has a thirty years lasting experience in the sector and can count on an innovative instrumentation, which is currently the most complete and advanced in Italy for the study of materials.

Reference market: Incremental innovation, Impacts on existing markets

Development stage: Industrialization

TRL: 8, 9

Advantages: Product/process/service/technology optimization

Patented technology: No

Technology validation/demonstration: External validation

Market positioning: Italian, European, International

Partner required: Enterprise, Private research center, Cooperation in national /european / international project

Key words: NMR, Materials, Solids, Structure, Dynamics

Url: *https://promott.cnr.it/en/technology/158/nuclear-magnetic-resonance-spectroscopy-for-solidor-soft-materials-and-systems*

APOBEC1 MUTANTS FOR THE DEVELOPMENT OF NEW BASE EDITORS WITH REDUCED RNA / DNA OFF-TARGETS

 # Record card: 159

Thematic areas

Health & Biotech
Health & Biotech / Bio-medicals
Health & Biotech / New therapies
Health & Biotech / Diagnostic kits

Description

The development of genome editing tools has revolutionized the way we think and deal with genetics. The use of Cas9 or its variants allows modifications of specific sites in the human genome by inducing deletions and insertions in a more or less controlled way. In recent years, a new class of tools for genome editing has emerged: the base editors (BE), which result from the fusion of a modified Cas9, which serves to direct the BE to the target, and an active deaminase acting on the DNA, which mediates the C> T or A> G editing. These molecules allow the modification of single bases in a specific DNA region without inducing double strand breaks, and therefore could be safer than using Cas9 alone. As for C> T editing, the most commonly used deaminase is rat APOBEC1, a powerful DNA mutator that acts physiologically on RNA.

Type of innovation: Product / process innovation in integration with an already existing technology

Description of innovative features / Competitive advantages

Despite their potential, several studies have shown that Base Editor expression in human cells causes off-target mutations in both RNA and DNA. To limit these mutations, we have used bacterial screening and assays in human cells to develop mutants of the APOBEC1 deaminase with substantially lower levels of off-target mutations both on RNA and on DNA. Their incorporation within base editors presents a considerably reduced number of off-target mutations both on RNA and DNA. These new base editors we have developed can be used to induce a safer genomic editing.

Reference market: Incremental innovation

Development stage: Prototype

TRL: 4

Advantages: Product/process/service/technology optimization

Patented technology: Yes

Country/ies: Italy

Publication of technology: In publication phase

Technology validation/demonstration: Internal validation

Market positioning: Italian, European, International

Partner required: Enterprise, Public research center/university, Private research center, Cooperation in national /european / international project

Key words: Base editors, Gene therapy, Genome editing, Mutations

Url: *https://promott.cnr.it/en/technology/159/apobec1-mutants-for-the-development-of-new-baseeditors-with-reduced-rna-dna-off*

LABEL-FREE MICROSCOPY METHODS FOR THE CHARACTERIZATION OF SAMPLES OF CLINICAL AND INDUSTRIAL INTERESTS

 # Record card: 160

Thematic areas

Chemicals & Physics
Chemicals & Physics / Imaging & image processing
Chemicals & Physics / Atomic and molecular spectroscopy
Health & Biotech
Health & Biotech / Diagnostic, Medical imaging & advanced bioimaging
Health & Biotech / Biosensors

Description

At IFN-CNR, in collaboration with Politecnico di Milano-Department of Physics, we have developed Raman microscopy approaches compatible with the study and characterization of biological and industrial samples. In detail, our facility houses a self-built spontaneous confocal Raman microscope with the following characteristics: two excitation lasers (660nm and 785nm), inverted microscope (Olympus IX-73) and Princeton spectrometer / CCD.

Type of innovation: Product / process innovation in integration with an already existing technology

Description of innovative features / Competitive advantages

Raman technology offers the possibility to study and characterize the chemical composition of various samples and materials in a non-destructive way and without the use of dyes. For example, Raman microscopy measurements make it possible to study cells or tissues in their physiological (aqueous) environment without altering their original composition.

Reference market: Incremental innovation, Impacts on existing markets

Development stage: Feasibility

TRL: 3

Advantages: New product/process/service/technology

Patentable technology: No

Patented technology: Yes

Country/ies: Italy, PCT

Publication of technology: Published

Technology validation/demonstration: Internal validation

Market positioning: Italian, European, International

Partner required: Enterprise, Public research center/university, Private research center, Seed capital, Cooperation in national /european / international project

Key words: Raman, Label-free, Hyperspectral imaging, Diagnosis, SERS

Url: *https://promott.cnr.it/en/technology/160/label-free-microscopy-methods-for-thecharacterization-of-samples-of-clinical-and*

AIDD - ARTIFICIAL INTELLIGENCE FOR DRUG DISCOVERY

 # Record card: 161

Thematic areas

Health & Biotech
Health & Biotech / Bio-informatics
Health & Biotech / Smart Devices for Health and Wellness
Health & Biotech / Development of new drugs
Energy and environmental sustainability
Energy and environmental sustainability / Simulation

Description

AIDD is an integrated tool and a radically new way to discovery new drugs for neurodegenerative diseases (Alzheimer's, Epilepsy, Ageing, etc.). It allows pre-testing possible therapeutic applications, using in silico detailed models of neurons and neuronal networks, leading to a smoother clinical implementation of new and/or more specific drugs with unique therapeutic properties. The major objective of the AIDD's computational approach is to provide the neuroscience community with a unique tool for drug discovery, to find a quantitative link between individual ion channel properties and mental diseases, integrating *in silico* biophysically detailed computational models with in vitro experiments, to accelerate the starting of the pre-clinical phase by cutting costs and time. The long-term vision is a research protocol that can greatly help the pharmaceutical industry in marketing new and more effective drugs, or better characterize the effects of already existing molecules, reducing animal experiments and the potential side effects of the drug.

Type of innovation: Service/know how innovation

Description of innovative features / Competitive advantages

AIDD is based on an innovative approach based on computational modeling and driven by experimental data. It allows to establish a quantitative link between the characteristics of ion channel expressed in the neurons' membrane and mental diseases/disorders. Implemented as a multi-scale modeling approach, AIDD allows bridging the gaps between molecular-cellular, computational and clinical neuroscience, to study synaptic transmission and plasticity, modulation of channel properties, and the effects of neuromodulation on cognitive disorders. Currently, the development of a possible pharmacological agent requires a strenuous, long, and extremely expensive experimental and clinical investigation before its use can be considered. The proposed technology is a game changer in the eld, because it allows a much faster and more efficient way to find drugs for the treatment of mental diseases and disorders, especially those involving hippocampus functions. This brain structure appears to be among the first to be affected by AD, epilepsies, schizophrenia and, more generally, cognitive problems with age. Preventing its functional decline is thus a crucial challenge.

Reference market: Impacts on existing markets

Development stage: Feasibility

TRL: 3, 4

Advantages: New product/process/service/technology

Patentable technology: No

Patented technology: No

Publication of technology: Published

Technology validation/demonstration: Internal validation

Market positioning: Italian, European, International

Partner required: Enterprise, Private research center, Seed capital, Cooperation in national /european / international project

Key words: Neuroscience, Pharma industry, Drug discovery

Url: *https://promott.cnr.it/en/technology/161/aidd-arti cial-intelligence-for-drug-discovery*

SUSTAINABLE APPLICATIONS OF RED GRAPE SKIN POMACE IN FUNCTIONAL BEVERAGES PRODUCTION

 # Record card: 162

Thematic areas

Agrifood

Agrifood / Nutrition & health

Bioeconomy

Energy and environmental sustainability

Energy and environmental sustainability / Renewable sources

Description

Grape pomace, a by-product of wine-making, is rich in polyphenols, metals, organic acids and can become a functional ingredient in food and beverage. The stabilisation of the pomace has been optimised to preserve the anti-inflammatory and antioxidant properties of the molecules present. Isolated grape skins have been reused in purity or in blends with other plant components as a base for: 1) herbal teas, 2) ready-to-drink functional beverages, 3) freeze-dried products. The beverages obtained are rich in polyphenols, mineral salts, organic acids and possess biological activity. The anti-inflammatory, endothelium-protective effect of aqueous grape pomace skin extracts has been demonstrated through the adhesion of endothelial monocytes, the first step in the development of atherosclerosis, and the expression of adhesion molecules in human endothelial cell culture. The extract reduces the expression of endothelial adhesion molecules (ICAM-1 and VCAM-1) at the lowest concentration used. Anti-inflammatory activity is enhanced in the infusion of pomace and tea, suggesting a possible synergistic effect for the development of a functional beverage.

Type of innovation: Product innovation

Description of innovative features / Competitive advantages

The new food products in the research phase possess the following competitive advantages: 1) development of a sustainable methodology that allows to transform an industrial waste into a second stable raw material, ready for a new industrial chain; 2) use of dehydrated skins separated from marc as a second raw material for the production of functional drinks rich in polyphenols and mineral salts. The drinks obtained from the blend of grape skins and black tea have a very high quantity of polyphenols and a very high antioxidant activity when compared with drinks on the market. In addition, the synergistic effect between the polyphenols in tea (catechins) and those in the skins (anthocyanins) allows for a high anti-inflammatory and protective activity on endothelial cells in vitro. The new functional drinks aim to achieve the following sustainability objectives in the National Strategy for Sustainable Development: 1) promote social and environmental responsibility in companies and administrations; 2) reduce the production of waste and promote the market for secondary raw materials; 3) develop a market for novel functional products.

Reference market: Impacts on existing markets

Development stage: Idea

TRL: 3

Advantages: New product/process/service/technology

Patentable technology: No

Patented technology: No

Publication of technology: Published

Technology validation/demonstration: Internal validation

Market positioning: Italian, European, International

Partner required: Enterprise, Public research center/university, Private research center, Cooperation in national /european / international project

Key words: Ploypheno ls, Grape pomace, Functional beverages, Nutraceutical industry, Circular economy

Url: *https://promott.cnr.it/en/technology/162/sustainable-applications-of-red-grape-skin-pomacein-functional-beverages-production*

SHAPE MEMORY JEWELRY FABRICATED THROUGH ADDITIVE MANUFACTURING ADDITIVA

 # Record card: 170

Thematic areas

Additive and advanced industrial manufacturing

Additive and advanced industrial manufacturing / Additive manufacturing processes and materials Materials

Materials / Metals & alloys

Description

The present technology deals with jewels based on shape memory alloys and fabricated through additive manufacturing. In ICMATE-Lecco laboratories, several NiTi-based rings have been fabricated through a powder bed fusion technology (selective laser melting technique). At the same time, a post-processing route has been implemented to promote the shape memory functionality and to improve the surface finish (polishing and coloring through oxidation). Thanks to the functional materials and the additive manufacturing (4D-printing) it is possible to fabricate functional and customized jewels with innovative design.

Type of innovation: Product / process innovation in integration with an already existing technology

Description of innovative features / Competitive advantages

The presented technology allows the development and fabrication of NiTi alloy jewels with an innovative design and capable of changing shape following thermal variations. The predefined shapes can be customized thanks to the use of the additive manufacturing. The main innovative feature of the presented technology is to obtain unique jewels in terms of shape and functionality. Reference market: Incremental innovation, Impacts on existing markets

Development stage: Prototype

TRL: 4

Advantages: Product/process/service/technology optimization

Patentable technology: Yes

Patented technology: No

Publication of technology: No

Technology validation/demonstration: External validation

Market positioning: Italian, European, International

Partner required: Enterprise, Public research center/university, Private research center, Cooperation in national /european / international project

Key words: Selective laser melting, 4D-printing, Shape memory alloy, NiTi, Jewelry

Url: *https://promott.cnr.it/en/technology/170/shape-memory-jewelry-fabricated-through-additivemanufacturing-additiva*

B-ME: BIO-BASED MATERIALS FOR ENERGY

 # Record card: 171

Thematic areas

ICT & Electronics - ICT & Electronics / Sensor/multi-sensor technology, instrumentation - ICT & Electronics / Internet of Things - ICT & Electronics / Nanotechnologies related to electronics and microelectronics - ICT & Electronics / Electronics and microelectronics – Bioeconomy – Materials - Materials / Photo-active & graphene-based materials - Materials / Semiconductors and Superconductors - Materials / Composite and hybrid materials - Materials / Plastics, polymers - Chemicals & Physics - Chemicals & Physics / Micro and nanotechnology related to physical, chemical and exact sciences Chemicals & Physics / Plastics & rubber - Chemicals & Physics / Special chemicals - Energy and environmental sustainability - Energy and environmental sustainability / Renewable sources - Energy and environmental sustainability / Energy storage and transport - Energy and environmental sustainability / Energy production, transmission and conversion - Energy and environmental sustainability / Pollution treatment (air, soil, water) - Energy and environmental sustainability / Environmental engineering/technologies - Energy and environmental sustainability / Wearable technologies - Energy and environmental sustainability / Sensory - Additive and advanced industrial manufacturing - Additive and advanced industrial manufacturing / Additive manufacturing processes and materials

Description

B-ME developed the first thermoplastic composite electrode lm based on bio-derived and biodegradable polyesters and carbon nano-fibers. It is metal-free, highly electrically conductive and possess good thermo-mechanical properties, a challenging combination of three features in a single product. This is the first-of-its-kind product, as, to the best of our knowledge, no thermoplastic biobased electrode film has been effectively produced and used so far. Our preliminary tests were made on 40 cm2 film electrodes, used for electrochemical measures in supercapacitors application, showing stability in acidic electrolyte over +1000 charge-discharge cycles. The application in battery and supercapacitor devices, already preliminarily demonstrated, will allow to substantially decrease the environmental impact of the current raw materials and fabrication processes. Besides sustainability these electrodes are lighter and more stable against corrosion with respect to metal counterparts.

Type of innovation: Product innovation, Process innovation

Description of innovative features / Competitive advantages

Currently electrochemical energy storage devices rely on metal foil electrodes with aluminum or copper in the easiest configurations. When advanced devices are fabricated (e.g. bipolar plates, aqueous supercapacitors) these electrodes, beyond low sustainability, high weight (density of Al
2.7 and Cu 8.9 vs. ca. 1.5 g/cm3 for carbon composites) and supply issues, are technically challenged by the chemical reactions (e.g. corrosion, oxidation, alloying) occurring at metal interfaces. Carbon electrodes are a desired solution to all these challenges, but their fabrication can be quite complex and material-specific, and their surface inertness often causes poor electrochemical responses. This led to no or limited practical use of carbon electrode foils in commercial energy storage devices. We believe that our product will represent a breakthrough providing a versatile platform product, lightweight, bio-based and metal-free, both electrochemically stable and with an improved response.

Reference market: Incremental innovation, Impacts on existing markets

Development stage: Feasibility

TRL: 3

Advantages: New product/process/service/technology, Product/process/service/technology optimization

Patentable technology: Yes

Patented technology: No

Publication of technology: No

Technology validation/demonstration: Internal validation

Market positioning: Italian, European, International

Partner required: Enterprise, Public research center/university, Seed capital, Cooperation in national /european / international project

Key words: Circular bio-economy, Carbon electrods, Bioplastics, Supecapacitor

Url: *https://promott.cnr.it/en/technology/171/b-me-bio-based-materials-for-energy*

FUNCTIONAL INGREDIENTS FROM AGRO-FOOD BYPRODUCTS

 # Record card: 172

Thematic areas

Agrifood

Agrifood / Nutrition & health

Description

The development of functional foods is often limited by industrial manufacturing processes, for example, for the production of baked foods, the use of high cooking temperatures causes denaturation of proteins, destruction of vitamins, alteration of fatty acids, etc. The protection of these components is essential in the production of gluten-free foods as they are generally poor in proteins and vitamins. Developing gluten-free foods enriched in proteins and vitamins using food by-products and developing production methods capable of preserving these biomolecules is the basis of the proposed technology.

Specifically, the production process of gluten-free functional foods involves 1. the identification of food by-products, 2. the transformation into our, 3. the creation of mixtures, 4. the production of bakery products with specially developed cooking methods

Type of innovation: Product / process innovation in integration with an already existing technology

Description of innovative features / Competitive advantages

The innovation lies in the use of food by-products for the production of ours or vegetable extracts to be used for the production of gluten-free functional foods and aimed at celiacs or gluten intolerant (gluten sensitivity or non-celiac gluten sensitivity). In the current gluten-free scenario, there are no functional foods whose health principles are derived from food by-products. In subjects who eliminate gluten from their diet, the use of products based on rice/corn our generates malnutrition as these ours have a low level of nutrients and a high level of sugar. In fact, such subjects often develop glucose intolerance. Developing enriched food products derived from the processing of certain plant products could enrich such foods. The biomolecules that would be obtained from food by-products would fortify these foods and make them more eco-sustainable.

Reference market: Impacts on existing markets

Development stage: Industrialization

TRL: 7

Advantages: New product/process/service/technology

Patentable technology: Yes

Patented technology: No

Publication of technology: No

Technology validation/demonstration: External validation

Market positioning: Italian, European, International

Partner required: Seed capital, Cooperation in national /european / international project

Key words: Gluten-free food, Food forti cation, Functional foods, Foods for celiac, Food from byproducts

Url: *https://promott.cnr.it/en/technology/172/functional-ingredients-from-agro-food-byproducts*

3D ORGANOTYPIC MODELS OF OVARIAN CANCER FOR COMBINATION PHARMACOLOGY APPLICATIONS

 # Record card: 173

Thematic areas

Health & Biotech

Health & Biotech / Bio-medicals

Health & Biotech / Development of new drugs

Description

Organotypic models of ovarian cancer are 3D models containing defined extracellular matrices, such as collagen and fibronectin, ovarian cancer cells with specific genetic/molecular characteristics, and one or more cancer-associated stromal cell types (fibroblasts, mesothelial cells, endothelial cells) to mimic specific metastatic niches of ovarian cancer (omentum, peritoneum, interstitial stroma) and the complex interactions within tumor tissues. These models allow for testing new anticancer drugs targeted for each subgroup and their combination with traditional chemotherapy drugs.

Type of innovation: Service/know how innovation

Description of innovative features / Competitive advantages

The innovative aspects concern the possibility of using the 3D organotypic tailored models of ovarian cancer as predictive models in vitro in the "priority test" in the translation between in vitro and in vivo. The 3D models can be used to test responses to new anticancer molecules alone or in combination with those in use in current clinical practice. This will allow for an effective low-cost selection of "lead" molecules to be sent to in vivo preclinical trials.

Reference market: Incremental innovation, Impacts on existing markets

Development stage: Prototype

TRL: 4

Advantages: Product/process/service/technology optimization, Cost reduction

Patentable technology: No

Patented technology: No

Publication of technology: Published

Technology validation/demonstration: Internal validation

Market positioning: Italian, European, International

Partner required: Enterprise, Public research center/university, Private research center, Cooperation in national /european / international project

Key words: Ovarian cancer, Organotypic 3D models, Tumor-stroma interactions, Targeted therapies

Url: *https://promott.cnr.it/en/technology/173/3d-organotypic-models-of-ovarian-cancer-forcombination-pharmacology-applications*

PLANT-BASED SYSTEMS FOR RECOMBINANT PROTEIN/PEPTIDE PRODUCTION

 # Record card: 174

Thematic areas

Agrifood

Agrifood / Nutrition & health

Health & Biotech

Health & Biotech / Development of new drugs

Health & Biotech / Regenerative Medicine

Description

Plants can compete favorably with traditional expression systems (mammalian cells, yeasts or bacteria) to produce recombinant proteins/peptides of pharmaceutical/industrial/agrifood interest. This technology names “Plant Molecular Farming”. The CNR-IBBA research team offers the study of new strategies for the expression and optimization of recombinant proteins/peptides in plant-based systems (plant tissues, transgenic plants, plant cell culture). Our pipeline is based on the following modules:

- ✓ Design of possible strategies to increase the yield of recombinant protein/peptide of interest in plant-based systems;
- ✓ Testing of different strategies by transient expression in plant tissues;
- ✓ Production of the prototype plant (or plant cell line) using the best strategy;
- ✓ Molecular and functional analysis (post-translational modifications, localization, etc.) of protein/peptide of interest produced in the prototype plant.

Type of innovation: Process innovation, Service/know how innovation

Description of innovative features / Competitive advantages

Plants can compete favorably with traditional expression systems (mammalian cells, yeasts or bacteria) to produce recombinant proteins/peptides of pharmaceutical/industrial/agrifood interest. This technology names “Plant Molecular Farming”. The CNR-IBBA research team offers the study of new strategies for the expression and optimization of recombinant proteins/peptides in plantbased systems (plant tissues, transgenic plants, plant cell culture). Our pipeline is based on the following modules: • Design of possible strategies to increase the yield of recombinant protein/peptide of interest in plant-based systems • Testing of different strategies by transient expression in plant tissues • Production of the prototype plant (or plant cell line) using the best strategy • Molecular and functional analysis (post-translational modifications, localization, etc.) of protein/peptide of interest produced in the prototype plant.

Reference market: Incremental innovation, Impacts on existing markets

Development stage: Feasibility

TRL: 2, 3, 4

Advantages: Product/process/service/technology optimization, Cost reduction

Patentable technology: Yes

Patented technology: No

Technology validation/demonstration: Internal validation

Market positioning: Italian, European, International

Partner required: Enterprise, Public research center/university, Private research center, Cooperation in national /european / international project

Key words: Plant molecular farming, Recombinant protein/peptide, Protein/peptide stability, Protein post-translational modi cation, Plant biotechnology

Url: *https://promott.cnr.it/en/technology/174/plant-based-systems-for-recombinantproteinpeptide-production*

PROCESS FOR THE PRODUCTION OF NANOCRYSTALS OF METAL CHALCOHALIDES

 # Record card: 175

Thematic areas

Materials - Materials / Processes of production & treatment of materials
Chemicals & Physics - Chemicals & Physics / Micro and nanotechnology related to physical, chemical and exact sciences - Materials / Semiconductors and Superconductors
Energy and environmental sustainability - Energy and environmental sustainability / Renewable sources
Energy and environmental sustainability / Energy production, transmission and conversion
ICT & Electronics - ICT & Electronics / Nanotechnologies related to electronics and microelectronics
Chemicals & Physics / Inorganic substances - Chemicals & Physics / Colours & dyes
Materials / Composite and hybrid materials - Materials / Optical materials

Description

The invention is a synthetic method to prepare colloidal nanomaterials of V-VI-VII semiconductors that do not contain toxic elements. This is the first method for the synthesis of mixed anion nanomaterials without toxic elements at large, which permitted to obtain, among others, bismuth chalcohalide nanocrystals that are arguably considered as one of main candidates to be the next big thing for light energy conversion. Our method permits to fully explore the ternary metalchalcogen-halogen phase diagram, providing access to a class of unexplored nanomaterials. Our synthetic method can be scaled up. Our materials show high chemical stability and superior light absorption properties. Our materials are dispersible in several media and can be used to formulate inks, pastes, and composites thus compatible with simple processing techniques (such as printing). Our materials can be processed into robust, conductive thin solid lms capable of producing a stable current upon light irradiation.

Type of innovation: Product innovation, Process innovation

Description of innovative features / Competitive advantages

High reliability of the process: our process is based on the controlled nucleation and growth of the nanocrystals in the solution phase, which are prepared by the hot-co-injection of the anion precursors in a metal complex solution. High versatility of the process: our method permits to fully explore the ternary metal-chalcogen-halogen phase diagram, providing access to a class of unexplored nanomaterials. Processability of the materials: our materials are dispersible in several media and can be used to formulate inks, pastes, and composites thus compatible with simple and cheap processing techniques (such as printing, spraying, blade coating). Rather reduced costs: our process occurs at relatively low temperatures (< 200 °C) for few minutes and utilizes common reagents. Scalability: presumed from the kinetic regime growth of the nanocrystals.

Reference market: Impacts on existing markets

Development stage: Feasibility

TRL: 3, 4

Advantages: New product/process/service/technology

Patented technology: Yes

Country/ies: Italy; PCT

Publication of technology: In publication phase

Technology validation/demonstration: Internal validation

Market positioning: Italian, European, International

Partner required: Enterprise, Public research center/university, Private research center, Cooperation in national /european / international project

Key words: Nanomaterials, V-VI-VII semiconductors, Chalcohalides, Inks and pastes, Light energy conversion

Url: *https://promott.cnr.it/en/technology/175/process-for-the-production-of-nanocrystals-of-metalchalcohalides*

ARTIFICIAL OLFACTORY SYSTEM FOR FISH FRESHNESS MONITORING

 # Record card: 176

Thematic areas

Measurement tools and Standards

ICT & Electronics

ICT & Electronics / Optoacustic sensors, Optoelectronic devices

Agrifood

Agrifood / Food quality & safety

Description

The proposed technology consists of a portable device for monitoring the freshness of fish, based on its smell. The device is based on a gas sensor and pattern recognition software to correlate the sensor signal to the freshness of the food. The technology is designed for its integration into domestic or industrial refrigerators.

Type of innovation: Product / process innovation in integration with an already existing technology

Description of innovative features / Competitive advantages

- ✓ The working principle is based on 'pattern recognition', it is not based on an analytical approach. This makes the system very flexible: it can be trained to recognize targets other than the freshness of the fish;
- ✓ Size comparable with a USB pen drive and reduced power consumption (controlled by PC via USB cable) which make the device portable and potentially suitable for integration in the working environment (ex: refrigerator);
- ✓ Obtained results have shown the capability of the system to identify the edibility (or non-edibility) of fresh fish at different temperatures (4-25°C).

Reference market: Incremental innovation

Development stage: Feasibility

TRL: 3

Advantages: Product/process/service/technology optimization

Patentable technology: No

Patented technology: No

Publication of technology: Published

Technology validation/demonstration: Internal validation

Market positioning: Italian, European, International

Partner required: Enterprise, Public research center/university, Private research center, Cooperation in national /european / international project

Key words: Arti cial olfactory system, Fish freshness, Gas sensors

Url: *https://promott.cnr.it/en/technology/176/arti cial-olfactory-system-for- sh-freshnessmonitoring*

PHAGE CONJUGATES AND USES THEREOF

 # Record card: 177

Thematic areas

Health & Biotech

Health & Biotech / Nanomedicine

Health & Biotech / Development of new drugs

Description

Filamentous bacteriophages for size, in vivo biodistribution and easiness of engineering, are considered as natural nanoparticles. The developed technology allows the construction of bio-nanoparticles based on filamentous bacteriophages delivering proteic antigens and immunomodulating lipids. Thanks to the high content of hydrophobic residues, phage capsid proteins have high binding a nity to lipids, allowing the conjugation of immunostimulating lipids. Phage particles can also be engineered for the high-density expression of tumor antigen-derived peptides and/or ligands or antibody fragments for the delivery to specific cell subpopulations. We thus conjugated bacteriophages with the glycolipid alpha-GalactosylCeramide and the in vivo administration of these nanoparticles was able to stimulate iNKT cells without inducing anergy, together with a strong adaptive immune response. Therapeutic vaccination with these bacteriophages is able to inhibit tumor growth in animal models.

Type of innovation: Product / process innovation in integration with an already existing technology

Description of innovative features / Competitive advantages

Bacteriophages replicate only in bacteria and are widely distributed in the environment, making them safe for human use. Their use in therapy against antibiotic-resistant bacterial infections is well-known and currently the object of clinical trials. The use of phages as a vehicle for immunomodulating lipids and tumor antigens for vaccination purposes has not yet been explored and is highly innovative. The proposed technology is focused on the development of innovative and more effective therapeutic strategies to attack cancer cells on several fronts and counteract the mechanisms of escape from the immune response, with the creation of a product that can be used in the fight against oncological diseases combining the pharmacological efficacy with the safety for administration in humans and advantageous production costs. The delivery of aGalCer using filamentous bacteriophages exceeds the current limitations of the use of aGalCer in antitumor therapy.

Reference market: Incremental innovation, Impacts on existing markets

Development stage: Prototype

TRL: 5, 6

Advantages: New product/process/service/technology

Patented technology: Yes

Country/ies: Europe; US

Publication of technology: Published

Technology validation/demonstration: Internal validation

Market positioning: Italian, European, International

Partner required: Enterprise, Public research center/university, Seed capital, Cooperation in national /european / international project

Key words: Filamentous bacteriophage, Immunostimulating lipid, Immunotherapy, Vaccine, iNKT

Url: *https://promott.cnr.it/en/technology/177/phage-conjugates-and-uses-thereof*

THERMOSETTING RESINS FROM VEGETABLE OILS

 # Record card: 178

Thematic areas

Chemicals & Physics
Energy and environmental sustainability
Energy and environmental sustainability / Renewable sources
Chemicals & Physics / Plastics & rubber
Materials
Materials / Composite and hybrid materials
Chemicals & Physics / Sustainable substances and green chemistry Materials / Plastics, polymers

Description

The substitution of fossil derived monomers in thermosetting resins is a very important point to look at to face environmental impact issues related with the use of traditional resins. The research group set up a protocol for the preparation of thermosetting resins starting from vegetable oils with different composition to substitute the petroleum-based monomers. The materials obtained in this way have a bio-based carbon content higher than 80%. Moreover, the use of terpenic comonomers allows one to avoid the use of styrene, a toxic and volatile reagent, thus entailing a further advantage in terms of safeness and environmental impact. The materials result to have mechanical and thermal properties tunable with the monomer and the starting oils choice, with glass transition temperatures and Young's modulus values comparable with styrene containing materials. The developed resins have been also employed in the preparation of composite laminates reinforced with natural fibers.

Type of innovation: Product innovation, Process innovation

Description of innovative features / Competitive advantages

The proposed materials derive from an emerging technology that finds in the use of reagents from vegetable sources its main advantage in terms of environmental impact and safeness. Vegetable oils combined with terpenes offer the opportunity to substitute traditional monomers from fossil source and to tap from a wide pool of primary sources: the proper choice of the starting oil/terpene mixture allows one to tune the properties of the final material. A great advantage also comes from the chance to use waste oils or residues of agro-industrial chains. The final materials, both resins and composites can find application in important industrial sectors ranging from automotive, to furniture and design. For these sectors the use of bio-based products not only offers a great environmental impact improvement, but also entails competitive advantages related with the consumer request, besides the company image and the need to face the even more urgent legislative restrictions.

Reference market: Impacts on existing markets

Development stage: Feasibility

TRL: 3, 4

Advantages: New product/process/service/technology

Patentable technology: Yes

Patented technology: No

Technology validation/demonstration: Internal validation

Market positioning: Italian, European, International

Partner required: Enterprise, Public research center/university, Private research center, Cooperation in national /european / international project

Key words: Biomaterials, Vegetable oils, Thermosetting resins, Bio-composites, Styrene-free

Url: *https://promott.cnr.it/en/technology/178/thermosetting-resins-from-vegetable-oils*

EXTRACTION OF HIGH PURITY GRADE PHYCOBILIPROTEINS

 # Record card: 179

Thematic areas

Agrifood
Agrifood / Nutrition & health
Chemicals & Physics
Chemicals & Physics / Colours & dyes
Chemicals & Physics / Separation technologies
Chemicals & Physics / Sustainable substances and green chemistry
Health & Biotech
Health & Biotech / Care, Hygiene, Cosmetics

Description

Method for extracting, with high yield, phycobiliproteins from cyanobacterial and/or algal biomass, obtaining aqueous extracts characterized by high concentration of pigments (4-5 mg/mL) and a purity, at least equal to food/cosmetic grade (P≥2). The process is characterized by a first step in which the cyanobacterial/algal cells are broken by ultrasonication in an ammonium sulphate solution, with simultaneous extraction of water-soluble compounds other than phycobiliproteins, and a second step in which phycobiliproteins are extracted using water or aqueous solutions. The method allowed to extract up to 95-98% of the phycobiliprotein content from Spirulina biomass obtaining bright blue crude extracts with P>3 and concentration up to 4-5 mg/mL. Bright fuchsia crude extracts of *Porphyridium cruentum* (principally containing B-phycoerythrin) were also obtained with P=4 and concentration of about 1 mg/mL.

Type of innovation: Process innovation

Description of innovative features / Competitive advantages

The method, which incorporates cell rupture and puri cation of the product in a single step, applies an inverse logic to the traditional one, as first it aims to eliminate the contaminating molecules (thus contributing to puri cation) and only after it aims to extract the compounds of interest (the phycobiliproteins) from the biomass. Production times are reduced (one day, biomass harvesting included), to the advantage of the product quality. Since both the chemical-physical and organoleptic characteristics (e.g., no unpleasant smells develop) are preserved.

Furthermore, it is possible to use any extracting solution deemed appropriate, obtaining very concentrated bright coloured extracts (a few mg/mL), with purity grade P > 2, without applying downstream puri cation processes.

These characteristics reduce production costs and make the method an excellent candidate for industrial-scale use.

Reference market: Incremental innovation, Impacts on existing markets

Development stage: Feasibility

TRL: 4

Advantages: New product/process/service/technology, Cost reduction

Patented technology: Yes

Country/ies: Italy; Europe

Publication of technology: Published

Technology validation/demonstration: Internal validation

Market positioning: Italian, European, International

Partner required: Enterprise, Cooperation in national /european / international project

Key words: Phycobiliprotein selective extraction, Ultrasonication, Ammonium sulphate, Spirulina, Porphyridium cruentum

Url: *https://promott.cnr.it/en/technology/179/extraction-of-high-purity-grade-phycobiliproteins*

SNP GENOTYPING ASSAY FOR THE VARIETAL AUTHENTICATION OF MUSTS AND WINES

 # Record card: 180

Thematic areas

Agrifood

Agrifood / Food quality & safety

Description

Wine is one of the economically most important beverages and may be subject to fraud and mislabelling, although that there are specific and strict rules protecting its authenticity in Europe. Single Nucleotide Polymorphisms (SNPs), recently identified and characterized thanks to advances in genomics, are considered the newest type of molecular marker for grapevine identification. The protocol developed for SNP detection by quantitative real-time PCR (SNP genotyping) is a highly promising assay for varietal authentication of 'Nebbiolo' wines, and it represent an excellent reference for future protocols for the detection of other grapevine varieties in wines. The substantial advances for the sector of the new SNP genotyping protocol could provide an effective system for the traceability of a beverage product, such as wine, relevant to the Italian economy.

Type of innovation: Service/know how innovation

Description of innovative features / Competitive advantages

The techniques used for the varietal identification of grapes in wines are traditionally based on chemical and biochemical parameters or on microsatellite molecular markers. However, such methods are time consuming and generally do not give reliable results in wines. The certification of DOC and DOCG productions is rigorously established by the regulations and is still mainly based on harvest quantity declarations. The method based on the amplification of new SNP markers allows identifying in wines the possible presence of grapes other than those indicated on the label, with: (i) high sensitivity and specificity in detecting DNA; (ii) reduced analysis time; and (iii) straightforward interpretation of results, even in non-specialised laboratories. The technology would contribute substantially to the protection of wine producers and consumers, and to make the assayed product more competitive in the wine market.

Reference market: Impacts on existing markets

Development stage: Feasibility

TRL: 4

Advantages: Product/process/service/technology optimization, Cost reduction

Patentable technology: Yes

Patented technology: No

Publication of technology: No

Technology validation/demonstration: Internal validation

Market positioning: Italian, European, International

Partner required: Enterprise, Public research center/university, Private research center, Cooperation in national /european / international project

Key words: Wine, Must, Grapevine, Genetic traceability, Molecular markers

Url: *https://promott.cnr.it/en/technology/180/snp-genotyping-assay-for-the-varietal-authenticationof-musts-and-wines*

GELLAN MICROGELS: AN INNOVATIVE TECHNOLOGY FOR THE PRESERVATION OF CULTURAGE HERITAGE

 # Record card: 181

Thematic areas

Chemicals & Physics

Chemicals & Physics / Micro and nanotechnology related to physical, chemical and exact sciences Materials

Materials / Plastics, polymers

Tourism, social sciences and cultural heritage

Tourism, social sciences and cultural heritage / Technologies for preservation of cultural heritage

Description

The proposed technology takes advantages of the huge potentialities of the gellan gum microgels in the preservation of cultural heritage. Microgels are polymeric gels particles with the micro and nanoscale size, whose soft nature is due to the presence of the aqueous solvent inside the particle. For their small size, they can easily diffuse in the environment and penetrate in the porous structure of paper and wood to act as cleaner agent. This technology has been defined in its basic concept and validated in laboratory showing promising results in the treatment of ancient paper. Now, an optimized implementation is taking place to increase the efficacy and to extend its use to artefacts of different nature, such as modern paper and wood. Since the technology is based on gellan gum, a well-known material in the cultural heritage sector, it already complies with the needs of the restorers because it allows a low stress treatment for the paper and gives the possibility to have a cleaning material which can be easily prepared and stored in the context of the small laboratories of restorers.

Type of innovation: Product innovation, Process innovation

Description of innovative features / Competitive advantages

With respect to conventional methods used for ancient paper treatment, i.e. wet cleaning (invasive for the artifact) or cleaning by macroscopic gels, as gellan hydrogels, the proposed microgels are able to clean the artefacts more effectively and in a shorter time (few minutes with respect to 1 hour application of the hydrogel), with lower costs with respect to the currently used gel or enzyme-based technologies. Moreover, the edible nature of gellan makes the technology green, biocompatible, safe for the restorers and environmental friendly. Gellan can be chemically modified by anchoring molecules to its carbonyl and hydroxyl groups thus improving the physical-chemical properties of the microgel or conferring new cleaning functionalities. The proposed technology is versatile and can be easily adapted to several developments and applications, as the treatment of modern paper and wood artifacts, to obtain an effective cleaning which takes into account the different composition and structure of these artifacts, with respect to ancient paper, and of the different characteristics of wood, depending on the natural source and treatment.

Reference market: Impacts on existing markets

Development stage: Feasibility

TRL: 2, 3

Advantages: New product/process/service/technology

Patentable technology: Yes

Patented technology: No

Publication of technology: No

Market positioning: Italian, European, International

Partner required: Public research center/university, Cooperation in national /european / international project

Key words: Polymer microgels, Gellan gum, Paper artefacts treatment, Cultural Heritage

Url: *https://promott.cnr.it/en/technology/181/gellan-microgels-an-innovative-technology-for-thepreservation-of-culturage-heritage*

METHOD FOR MANUFACTURING A MEDICAL PATCH FOR THE LOCAL AND CONTROLLED RELEASE OF BIOACTIVE SUBSTANCES FOR THE TREATMENT OF CHRONIC ULCERS, AND A MEDICAL PATCH OBTAINED BY THIS METHOD

 # Record card: 182

Thematic areas

Health & Biotech - Health & Biotech / Bio-medicals - Health & Biotech / New therapies - Health & Biotech / Medical Device - Health & Biotech / Regenerative Medicine

Description

An innovative approach for the treatment of diabetic and venous ulcers, characterized by a di cult healing process and therefore at potential risk of infection and therefore of hospitalization and amputation of the limb, is represented by the local administration of "bioactive" factors through the use of synthetic and/or biological matrices that allow a gradual and controlled release in order to obtain a better and faster healing. The object of the present invention relates to the method for the preparation of an advanced dressing, in which the bioactive factors, in the specific case platelet lysate (PL) obtained from umbilical cord blood (CB) [CB-PL] and plasminogen (PLG), are both loaded into the dressing at the time of manufacture. A biodegradable dressing is thus obtained in which CB-PL and PLG are loaded into a cross-linked brin matrix obtained through a three (3) way spray deposition process in which a solution of fibrinogen, one of thrombin and one containing the “bioactive” factors (CB-PL and / or PLG), are sprayed separately, but at the same time, in a convergent way on a rotating cylindrical support. The CB-PL and PLG loaded brin dressing was manufactured using spray technology. The spray technology used made use of an equipment present in the "Laboratory of Biomaterials and Regenerative Medicine" of IFC-CNR and called "Advanced Spray-Machine". This particular equipment is equipped with a system of three converging jet spray guns which allows the solute contained in three different solutions to be deposited, by means of a separate spray - but at the same time, on a rotating cylindrical mandrel. With this technology it was possible to obtain the formation of a consistent layer of cross-linked brin (in other words mechanically resistant) on a rotating mandrel.

Type of innovation: Product innovation, Process innovation

Description of innovative features / Competitive advantages

The patent idea consists in the administration of "bioactive" factors through the use of a patch of elastic and mechanically consistent brin that can be easily cut and applied to a wound, allowing the local and controlled release of bioactive factors at the site of the injury. The technical problem that the invention solves concerns the preparation of an advanced dressing, in which the bioactive factors, in the specific case platelet lysate (PL) obtained from umbilical cord blood (CB) [CB-PL] and/or plasminogen (PLG), are both loaded into the dressing at the time of manufacture. With this method, a biodegradable dressing is obtained in which CB-PL and/or PLG are loaded into a crosslinked brin patch obtained by a three (3) way spray deposition process in which a solution of fibrinogen, one of thrombin and one containing the “bioactive” factors (CB-PL and/or PLG), are sprayed separately, but at the same time, in a convergent way on a rotating cylindrical support. The main advantage of the method described, that is the separate deposition of fibrinogen on a rotating support and the simultaneous deposition of thrombin (spray at low ow in order to avoid dripping phenomena with consequent loss of material), is to allow a cross-linking of fibrinogen (which is transformed into brin) in thin sequential layers until the formation of a certain thickness of brin. All the intimately cross-linked layers contribute to the formation of an elastic and mechanically resistant patch of brin only, which can be applied and adapted as easily to a wound as any other dressing.

Reference market: Incremental innovation, Impacts on existing markets

Development stage: Prototype

TRL: 4, 5, 6

Advantages: New product/process/service/technology

Patented technology: Yes

Country/ies: Italy; PCT

Technology validation/demonstration: Internal validation

Market positioning: Italian, European, International

Partner required: Enterprise, Public research center/university, Seed capital, Cooperation in national /european / international project

Key words: Fibrin patch, Umbilical cord blood platelet rich plasma UCB-PRP, Umbilical cord blood platelet lysate UCB-PL, Platelet Rich plasma PRP, Plasminogen PLG

Url: *https://promott.cnr.it/en/technology/182/method-for-manufacturing-a-medical-patch-for-thelocal-and-controlled-release-of*

INNOVATIVE MINERAL SUNSCREENS FOR SAFER AND MORE ECO-SUSTAINABLE PROTECTION: THE NATURE-INSPIRED TITANIUM-APATITES

 # Record card: 183

Thematic areas

Materials - Materials / Ceramic materials - Materials / Composite and hybrid materials
Chemicals & Physics - Chemicals & Physics / Sustainable substances and green chemistry
Energy and environmental sustainability - Tourism, social sciences and cultural heritage / Safety and security
Health & Biotech - Health & Biotech / Care, Hygiene, Cosmetics

Description

This technology concerns the development of new eco-sustainable UV physical/mineral filters with the aim of offering important innovations per the cosmetic sector. This, encouraged by European initiatives in the Green-Deal context, is constantly looking for new components with improved protection of the human health and the environment. These filters are constituted of particles based on hydroxyapatite (HA), an inorganic calcium-phosphate compound constituting the mineral phase of hard connective tissues such as bones and teeth, and therefore characterized by excellent biocompatibility. They are synthesized by though a nature-inspired biomineralization process which allows to obtain hybrid particles (HA/biopolymer) active in sun protection, totally biodegradable and inert towards organic components (e.g. of creams and collagen of skin) and therefore highly safe and eco-sustainable. This technology will make it possible to develop photostable and more effective solar products with limited secondary effects that pay greater attention to the protection of humans and marine ecosystems.

Type of innovation: Product innovation

Description of innovative features / Competitive advantages

Between the most innovative aspects offered by this technology: • the biomineralization process used for the synthesis allows the development of particles whose chemical composition and crystallinity degree allow their progressive dissolution in aqueous environments, releasing safe byproducts; • the particles have demonstrated the ability to increase the SPF of sunscreen products; • they are photo-stable, preserving the chemical lters from photo-degradation and guaranteeing a high skin tolerance of the product; • their hybrid nature facilitates the formulation of stable sunscreen products and their application on the skin, generating a light lm with a comfortable and aesthetically pleasing texture; • in compliance with the rules governing the use of nanomaterials in cosmetics, the morphology of these particles is designed ad-hoc to reduce the risk of permeation of cell membranes. This technology represents a valid, safer and eco-sustainable alternative to traditional physical lters (TiO2 and ZnO), and a concrete opportunity for innovation aimed at greater protection of human health and of the environment.

Reference market: Incremental innovation, Impacts on existing markets

Development stage: Prototype

TRL: 7

Advantages: New product/process/service/technology

Patentable technology: No

Patented technology: Yes

Country/ies: Europe; PCT

Publication of technology: In publication phase

Technology validation/demonstration: Internal validation

Market positioning: Italian, European, International

Partner required: Enterprise, Private research center, Seed capital

Key words: Sunscreens, Eco-sustainability, Hydroxyapatite, UV lters, Biomimetics

Url: https://promott.cnr.it/en/technology/183/innovative-mineral-sunscreens-for-safer-and-moreeco-sustainable-protection-the

PRINTABLE THERMOCHROMIC POLYMER COMPOSITE BASED ON HYBRID PEROVSKITE

 # Record card: 184

Thematic areas

ICT & Electronics

ICT & Electronics / Sensor/multi-sensor technology, instrumentation

ICT & Electronics / Nanotechnologies related to electronics and microelectronics

Energy and environmental sustainability

Energy and environmental sustainability / Rational use of energy

Materials

Materials / Composite and hybrid materials

Description

We developed an hybrid organic-inorganic composite consisting of a 2D perovskite and a copolymer. At room temperature the composite is highly transparent in the visible region with transmittance > 90%. At higher temperatures, the movement of the polymer chains releases the precursors, allowing the perovskite formation, which results in a colored film. The color changes according to the 'n' value of the PVK. PVK with n=1 starts coloring at 70°C, achieving a ΔT_{max} = 91.5% at 510 nm. On the other hand, PVK with n=2 and 3 starts coloring only at 120°C achieving a ΔT_{max} = 90.5% and 91.8% at 577 nm and 618 nm, respectively. The process is fully reversible: once the temperature has been lowered, the polymer again intercalates PVK reagents, going back to the transparent phase. The times required for coloring and bleaching are in the order of tens of seconds.

Type of innovation: Process innovation

Description of innovative features / Competitive advantages

One of the main innovative aspects of the developed composite lies in the mechanism of its thermochromism. Hybrid perovskite-based thermochromic systems already known in the literature show this phenomenon following the adsorption and desorption of volatile molecules, therefore it is necessary to use a controlled atmosphere to observe the color transition as a function of temperature. Instead, the thermochromism of the developed composite material depends on perovskite assembly and disassembly processes induced by the presence of a polymeric chain. As a result, the system works in normal environmental conditions, thus showing greater versatility. Another innovative aspect of the present technology is represented by the possibility of controlling the color and the transition temperature of the thermochromic film without the need for complex synthesis processes or complicated and expensive deposition processes.

Reference market: Incremental innovation

Development stage: Feasibility

TRL: 3, 4

Advantages: New product/process/service/technology

Patented technology: Yes

Country/ies: Italy

Publication of technology: Published

Technology validation/demonstration: Internal validation

Market positioning: Italian, European, International

Partner required: Enterprise, Public research center/university, Private research center, Cooperation in national /european / international project

Key words: Polymer-perovskite composite, Hybrid organic-inorganic perovskites, Thermochromism, Smart windows, Thin lms

Url: https://promott.cnr.it/en/technology/184/printable-thermochromic-polymer-composite-basedon-hybrid-perovskite

WSENSE FULL CONNECTIVITY FOR THE INTERNET OF UNDERWATER THINGS

 # Record card: 185

Thematic areas

Energy and environmental sustainability
Energy and environmental sustainability / Environmental engineering/technologies
Aerospace and Earth Science
Aerospace and Earth Science / Oceanography
Energy and environmental sustainability / Marine technologies
ICT & Electronics
ICT & Electronics / Internet of Things
Aerospace and Earth Science / Satellite technologies

Description

WSense provides customizable and modular real-time, bi-directional, in-situ monitoring tools capable of sending real-time alarms. It makes possible to monitor the entire water column, on areas that can scale from a few tens of square meters to hundreds or thousands of square meters depending on the number of nodes deployed as needed. The monitoring system is implemented using submarine wireless communication nodes (W-Nodes) integrated with probes to monitor various parameters. The W-Nodes are able to analyze the measured values, process them and transmit them in real time through the submarine wireless networks on which WSense has international patents. The signal containing the data can be forwarded by other W-Nodes which act as routers until it reaches a W-Gateway, a surface element which interfaces submarine networks with traditional networks and the Internet. The data is then transmitted to a Cloud software platform to be memorized, correlated, analyzed and displayed via a web interface, even in 3D for some scenarios designed to work on a PC, tablet, phone.

Type of innovation: Product innovation, Process innovation

Description of innovative features / Competitive advantages

WSense brings to the market submarine wireless mesh technology to create adaptive "multi-hop" networks that bring reliability and performance not possible until now. Wireless monitoring systems are also more reliable and less expensive than wired systems and reduce Operations & Maintenance costs, favoring the development of the Blue Economy. Wsense builds low-cost systems able to cover large areas in the coastal strip (up to 300m deep) to be deployed without cables to monitor the water column. On top of these patented solutions that derive from a decade of research and development of intellectual property, WSense has added, to realize its IoUT solutions, new acoustic modem technologies with low energy consumption and low cost; a submarine sensor node to which new sensors from different manufacturers can be easily integrated; a power management module capable to signi cantly increase the energy autonomy of the monitoring system; a multi-protocol stack for secure data transmission. A nal characterizing aspect of WSense solutions is multi-vendor interoperability.

Reference market: Total innovation, Creation of new markets

Development stage: Industrialization

TRL: 9

Advantages: New product/process/service/technology

Patentable technology: Yes

Patented technology: Yes

Country/ies: Italy; Europe; UK; Norway; Chile; Canada; US

Publication of technology: Published

Technology validation/demonstration: External validation

Market positioning: Italian, European, International

Partner required: Enterprise, Public research center/university, Private research center, Cooperation in national /european / international project

Key words: Internet of Underwater Things, Underwater Cableless Communication

Url: *https://promott.cnr.it/en/technology/185/wsense-full-connectivity-for-the-internet-ofunderwater-things*

OPTOELECTRONIC ACCELEROMETER SYSTEM FOR PANTOGRAPHS

 # Record card: 237

Thematic areas

ICT & Electronics

ICT & Electronics / Sensor/multi-sensor technology, instrumentation

ICT & Electronics / Optoacustic sensors, Optoelectronic devices

Description

The proposed technology is based on the concept of Power-Over-Fibre (PoF), which involves the transmission of data and power over an optical fiber. This technology is suitable for applications where traditional copper cabling is impractical or undesirable. This is the case with pantographs, where there is a large potential difference between the catenary and the earth, and therefore any electrical contact must be avoided for safety reasons. Furthermore, pantographs operate in an environment with very high electromagnetic interference (EMI). In this context, optical fiber, which is inherently insensitive to EMI, can enable an optoelectronic accelerometer to be energized and the accelerometer signals to be transmitted without creating any electrical contact between the train and the high-voltage region.

Type of innovation: Product / process innovation in integration with an already existing technology

Description of innovative features / Competitive advantages

- Safety: PoF eliminates the risk of electrical shock, making it safer for on-board applications.
- Reduced weight: Optical fibres are light and flexible compared to copper cables, making them ideal for use in the thin, curved structure of a pantograph, without adding significant weight or bulk.
- Electromagnetic immunity: Optoelectronic components are less affected by electromagnetic interference, ensuring accurate and reliable sensor readings.
- Reliability: Optical fibres are less susceptible to interference and offer more reliable data transmission than conventional electrical cables.

Reference market: Incremental innovation, Impacts on existing markets

Development stage: Prototype

TRL: 3, 4

Advantages: New product/process/service/technology

Patentable technology: Yes

Patented technology: No

Publication of technology: No

Technology validation/demonstration: Internal validation

Market positioning: Italian, European, International

Partner required: Enterprise, Public research center/university, Private research center, Cooperation in national /european / international project

Key words: Power-Over-Fibre, Optical power transmission, Optoelectronic accelerometer, Electromagnetic interference immunity

Url: *https://promott.cnr.it/en/technology/237/optoelectronic-accelerometer-system-forpantographs*

MACHINE LEARNING FOR MERGERS AND ACQUISITIONS

 # Record card: 238

Thematic areas

ICT & Electronics

ICT & Electronics / Information processing, information system, workflow management

Tourism, social sciences and cultural heritage / Socio-economic models

Description

Mergers e Acquisitions represent important forms of business deals because of the volumes involved in the transactions and the role of the innovation activity of companies. By considering the patent activity of about one thousand companies, we develop a method to predict future acquisitions by assuming that companies deal more frequently with technologically related ones. We address both the problem of predicting a pair of companies for a future deal and that of finding a target company given an acquirer. We compare different forecasting techniques, including machine learning and network-based algorithms, showing that our measure of similarity between companies outperforms the other approaches. Finally, we present the Continuous Company Space, a two-dimensional representation of firms to visualize their technological proximity and possible deals. Companies and policymakers can use this approach to identify companies most likely to pursue deals or explore possible innovation strategies.

Type of innovation: Service/know how innovation

Description of innovative features / Competitive advantages

Using our technology, companies can find the best partners for a deal (merger, acquisition, etc.). This recommendation stems from the construction of a space of companies, whose relative distance is computed using network science and machine learning. In this space, two companies are "close" from a technological point of view, so if the two have similar patenting activities. However, a target firm could be recommended to an acquiring company because of its distance, if the acquirer is looking for a complementary patenting activity, or wants to enter a new market.

Reference market: Incremental innovation

Development stage: Feasibility

TRL: 2, 3

Advantages: Product/process/service/technology optimization

Patentable technology: No

Patented technology: No

Publication of technology: Published

Technology validation/demonstration: Internal validation

Market positioning: Italian, European, International

Partner required: Enterprise, Public research center/university, Private research center, Seed capital, Cooperation in national /european / international project

Key words: Mergers and Acquisitions, Corporate Innovation, Patenting activity, Machine Learning

Url: https://promott.cnr.it/en/technology/238/machine-learning-for-mergers-and-acquisitions

“BLUE” CALCIUM CARBONATE RESULTING FROM BIVALVE MOLLUSC SHELLS

 # Record card: 239

Thematic areas

Bioeconomy
Energy and environmental sustainability
Energy and environmental sustainability / Renewable sources
Health & Biotech
Health & Biotech / Care, Hygiene, Cosmetics
Energy and environmental sustainability / Waste management
Additive and advanced industrial manufacturing
Energy and environmental sustainability / Pollution treatment (air, soil, water)
Chemicals & Physics
Chemicals & Physics / Inorganic substances
Additive and advanced industrial manufacturing / Additive manufacturing processes and materials Materials
Materials / Ceramic materials
Chemicals & Physics / Sustainable substances and green chemistry
Materials / Paper technology
Materials / Plastics, polymers

Description

Bivalve mollusk shells are made mainly of $CaCO_3$ (ca 95%), with a small fraction of organic material. If from these shells this mineral is retrieved, they could become a renewable and sustainable “mine” of a “blue” $CaCO_3$. Bivalve mollusk shells, also after the removal of the animal flesh, maintain a certain quantity of organic substances, part in the muscle and part in the shell. Therefore, as the first step of the “blue” $CaCO_3$ production, it is necessary to completely remove organic components, firing shells into an appropriate furnace after washing to remove salts. Successively, they have to be transformed at the form and dimensions specific for each expected product, grinding them by a suitable mill equipment. To maintain the carbon footprint, all the process has to be carried out in an engineered plant designed to operate using a green protocol. The waste resulting from the firing process could be reused further in the building sector, such as additive or admixture in lime mortars.

Type of innovation: Product innovation, Process innovation

Description of innovative features / Competitive advantages

Now, bivalve mollusk shells are not considered a waste that can be re-used, while they can represent a full-fledged renewable secondary raw material. A new regulation, followed at a local and national level, would be propaedeutic for the creation of a not yet existing value chain. In a perspective of circular economy, starting from the recovery of the shells a “blue” $CaCO_3$ can be reached, absolutely renewable and sustainable, in contrast to that mined, which is currently used in every industrial application. No attempt evaluated the use of a shell derived $CaCO_3$ in any industrial fields to date, except building (unsustainable because of the big quantities required) and poultry feed. Possible high added value applications can be in the production of paper, cosmetics and nutraceutics, plastics, glass, which conversely require limited quantities of $CaCO_3$.

Reference market: Impacts on existing markets

Development stage: Feasibility

TRL: 3

Advantages: New product/process/service/technology

Patentable technology: Yes

Patented technology: No

Technology validation/demonstration: Internal validation

Market positioning: Italian, European, International

Partner required: Enterprise, Public research center/university, Private research center, Cooperation in national /european / international project

Key words: Circular economy, End of waste, Blue calcium carbonate, Mollusc shell, High valueadded products

Url: *https://promott.cnr.it/en/technology/239/blue-calcium-carbonate-resulting-from-bivalvemollusc-shells*

MULTISENSORY SOFT INTERACTIVE TOY CALLED “TRANSITIONAL WEARABLE COMPANION TWC”, TO SUPPORT THERAPISTS IN EARLY INTERVENTION OF NEURODEVELOPMENTAL DISORDERS

 # Record card: 240

Thematic areas

Health & Biotech

Health & Biotech / Smart Devices for Health and Wellness

ICT & Electronics

ICT & Electronics / Electronics and microelectronics

Description

"Transitional Wearable Companions'' (TWC) are interactive, multisensory, animal-shaped soft toys, developed as a support tool for early intervention in neurodevelopmental disorders (NDD), with particular reference to Autism Spectrum Disorders (ASD). Thanks to internal electronics, TWC can emit coloured lights, nice sounds and mild vibrations when touched on the paws. Such stimulations are usually very reinforcing to children and attract their attention. TWCs can be used by the therapist to stimulate children's social skills (imitation, shared attention, eye contact) through sensorimotor games. Using a control app, the therapist can also adapt the TWC's responses (colour of lights, type of sound or music) to the child's preferences, to increase their interest. In this way, the TWC remains a stimulating game that keeps the child's attention high.

Type of innovation: Product innovation

Description of innovative features / Competitive advantages

TWCs, as a potential product, lie somewhere between classic interactive toys for young children (such as interactive puppets, which are fun but limited in their operation), and more advanced technologies aimed at older children (such as robots or virtual reality, which are very stimulating but complex to use). In practice, TWCs are simple enough to be used with young children, but interesting and complex enough to arouse the subject's interest and participation. This 'niche of use' has been confirmed by numerous therapists, who have viewed TWCs at trade fairs, and who have described them as innovative devices that are currently not available on the market. Moreover, TWCs, thanks to their internal electronics, can collect behavioural data, which is useful for monitoring the child's social skills. This makes TWCs a potential research tool as well as a therapy support tool.

Reference market: Creation of new markets

Development stage: Prototype

TRL: 4

Advantages: New product/process/service/technology

Patentable technology: No

Patented technology: Yes

Country/ies: Italy

Publication of technology: Published

Technology validation/demonstration: Internal validation

Market positioning: Italian, European, International

Partner required: Enterprise, Private research center, Cooperation in national /European / international project

Key words: Early intervention, Technology-based Intervention, Neurodevelopmental disorders, Interactive Technologies, Interactive toys

Url: *https://promott.cnr.it/en/technology/240/multisensory-soft-interactive-toy-called-transitionalwearable-companion-twc-to*

SYNTHETIC ORGANIC SEMICONDUCTOR MATERIALS FOR ELECTROCHROMIC DEVICES

 # Record card: 241

Thematic areas

Materials - Materials / Semiconductors and Superconductors - Energy and environmental sustainability - Energy and environmental sustainability / Rational use of energy - Health & Biotech - Health & Biotech / Diagnostic, Medical imaging & advanced bioimaging - Automotive transport and logistics - Automotive transport and logistics / Vehicles - Chemicals & Physics - Energy and environmental sustainability / Sensory Chemicals & Physics / Organic substances - Chemicals & Physics / Colours & dyes - ICT & Electronics / Electronics and microelectronics - Chemicals & Physics / Sustainable substances and green chemistry - Materials / Optical materials - Chemicals & Physics / Atomic and molecular spectroscopy ICT & Electronics

Description

Electrochromism is an optoelectronic characteristic of particular interest because it can be exploited in the creation of technologies such as smart windows (Smart Windows) to promote energy efficiency, automotive, sensor or visualization devices. Electrochromic materials change their optoelectronic characteristics, showing different colors depending on the applied electric field. Of particular interest are infrared electrochromic materials and devices (IR-ECD) that dynamically adjust the IR optical properties of objects as they can be exploited for thermal regulation of buildings. The electrochromic materials that are designed and synthetized in our laboratories are organic molecules, highly responsive semiconductors at low potential values following which they change color from ultraviolet up to infrared, resulting in excellent materials for energy saving.

Type of innovation: Product innovation

Description of innovative features / Competitive advantages

The organic electrochromic materials that we develop have the characteristic of modulating their absorption from the ultraviolet region, visible to the near infrared-infrared under the application of low potential values. The innovative aspects are linked to their preparation and their electrochromic properties: 1-they are made using sustainable and low-cost synthesis methodologies; 2- they can be made in large quantities, 3- they can be easily structurally modulated so as to always have original and singular chemical-physical and electrochromic properties, 4- they are easily processable; 5-they can take on different colors depending on the potential difference applied, going from a colorless condition to a "full black". Electrochromic devices made with these materials have high optical contrast, fast response times and excellent stability in changing color which exceeds 10,000 cycles.

Reference market: Incremental innovation

Development stage: Prototype

TRL: 4

Advantages: New product/process/service/technology, Cost reduction

Patentable technology: No

Patented technology: No

Publication of technology: Published

Technology validation/demonstration: Internal validation

Market positioning: Italian, European, International

Partner required: Enterprise, Public research center/university, Private research center, Cooperation in national /european / international project

Key words: Electrochromic Organic Materials, Organic Dyes, Smart windows, Automotive, Smart dyes camou age

Url: *https://promott.cnr.it/en/technology/241/synthetic-organic-semiconductor-materials-forelectrochromic-devices*

4Ts GAME

 # Record card: 242

Thematic areas

Tourism, social sciences and cultural heritage
ICT & Electronics
Tourism, social sciences and cultural heritage / Technologies for preservation of cultural heritage
Tourism, social sciences and cultural heritage / Education & learning
ICT & Electronics / IT and Telematics applications
ICT & Electronics / Augmented Reality
ICT & Electronics / Multimedia
Tourism, social sciences and cultural heritage / Socio-economic models
Tourism, social sciences and cultural heritage / Multimedia technologies

Description

4Ts Game was born in ITD in 2017 to indicate a board game for teacher training, which aims to develop skills in designing collaborative learning activities. The game was originally conceived as a 'tangible' game, consisting of a board and 4 decks of paper cards which contain inputs that guide the teachers/players' design process. Subsequently the game evolved and was developed in its digital version. In this version, developed in Unity and with an underlying knowledge base in Prolog, the game is able to provide feedback to teachers regarding the design/game choices made. Finally, a 'hybrid' format version was also created, which keeps the board and cards in paper format, but uses the digital component to provide feedback. 4Ts Game is available in 4 languages and is designed to be easily translated into other languages and customizable based on the context. For game documentation see: https://sites.itd.cnr.it/4TsGame/

Type of innovation: Product / process innovation in integration with an already existing technology

Description of innovative features / Competitive advantages

4Ts Game contains elements of educational innovation (there are no games with the same purpose) and technological innovation (the hybrid setting was created ad hoc and is new, as it is featured with QR codes that detect the cards on the board, thus providing feedback basing on their position and associations among cards). The game code is Open Source, having been developed in the context of European projects. Consequently, all its components can be downloaded free of charge from the website and can be easily 'customised' by the user. The rationale is that the game can be used in the context of teacher training by any institution/school/training body wishing to develop learning design skills with a playful approach. The possible applications of the product are scientific (research in the serious games sector for teacher training, research in the interaction design sector in the development of games, especially hybrid games) and use in the context of teacher training initiatives (in school or university).

Reference market: Impacts on existing markets

Development stage: Prototype

TRL: 3, 4, 5

Advantages: New product/process/service/technology

Patentable technology: No

Patented technology: No

Publication of technology: Published

Technology validation/demonstration: External validation

Market positioning: Italian, European, International

Partner required: Enterprise, Public research center/university, Private research center, Cooperation in national /european / international project

Key words: Serious game, Board game, Teacher training, Multimodal game, Learning design

Url: *https://promott.cnr.it/en/technology/242/4ts-game*

METHOD TO MEASURE THE REFRACTIVE INDEX OF A SAMPLE USING SURFACE PLASMON POLARITONS

 # Record card: 243

Thematic areas

ICT & Electronics - ICT & Electronics / Laser technologies - Tourism, social sciences and cultural heritage / Archeometry - Tourism, social sciences and cultural heritage / Safety and security - ICT & Electronics / Optics & Acoustic – Agrifood - Energy and environmental sustainability - Health & Biotech - Agrifood / Food quality & safety - Additive and advanced industrial manufacturing - Health & Biotech / Biosensors - Energy and environmental sustainability / Sensory - Additive and advanced industrial manufacturing / Factory of the Future Measurement tools and Standards - Tourism, social sciences and cultural heritage - ICT & Electronics / Microwaves and RF

Description

This invention comprises an interrogation and readout differential method for chemical sensors based on Surface Plasmon Resonances (SPR). The integration of the SPR sensing unit (chip or other), as intermediate reflecting element of a Fabry-Perot (FP) optical resonator, is the starting point for the application of this method. A Surface Plasmon Resonance can be only coupled by radiation p-polarized, referencing to the chip incidence plane, while no coupling is possible by s-polarized radiation. Two different modal systems of the FP, corresponding to the two orthogonal polarizations, are non-degenerate in frequency because of the different SPR coupling behavior. A p-polarized field can be considered as a probe and an s-polarized field as a reference, once they are simultaneously resonating in the cavity. Starting from this, an optical heterodyne readout system is implemented based on the detection of the beat note of the intracavity resonating radiation fields.

Type of innovation: Product innovation, Process innovation

Description of innovative features / Competitive advantages

Surface Plasmon Resonance based Sensors are suitable in detection of molecular targets dispersed in liquid phase at ultra-low concentration. The state-of-the-art methods for the interrogation and readout of the sensors are limited in performances by the technical noise. The radiation source maps its amplitude noise into the final measurement, while the optical apparatus pickups the acoustical vibrations from the environment. Differential and interferometric architectures, based on phase-detection, have been demonstrated as the most promising for high performances apparatuses. The main limit of these approaches stands in the delicate setups involved. The sensitivity depends on the interferometric arms length, i.e. it scales with the size of the apparatus. A new differential readout approach is demonstrated here, based on a direct frequency readout obtained by a purely optical down-conversion process to radiofrequency range. The method is particularly suited for optical integration in a waveguide setup. This opens the way to the devising of high performances compact SPR chemical sensors.

Reference market: Creation of new markets

Development stage: Feasibility

TRL: 3, 4

Advantages: New product/process/service/technology

Patentable technology: No

Patented technology: Yes

Country/ies: US and Europe

Publication of technology: Published

Technology validation/demonstration: Internal validation

Market positioning: Italian, European, International

Partner required: Enterprise, Private research center, Cooperation in national /european / international project

Key words: Chemical sensing, Surface plasmon resonance, Optical resonator, Direct frequency readout, Noise suppression

Url: *https://promott.cnr.it/en/technology/243/method-to-measure-the-refractive-index-of-a-sampleusing-surface-plasmon-polaritons*

A.L.I.C.E. PROJECT ("ACTUATORS BASED ON LIGHT-SENSITIVE COMPOSITE")

 # Record card: 244

Thematic areas

ICT & Electronics - ICT & Electronics / Laser technologies
ICT & Electronics / Sensor/multi-sensor technology, instrumentation
ICT & Electronics / Optics & Acoustic - ICT & Electronics / Robotics and control systems
ICT & Electronics / Optoacustic sensors, Optoelectronic devices
ICT & Electronics / Nanotechnologies related to electronics and microelectronics
Additive and advanced industrial manufacturing - Materials - Materials / Composite and hybrid materials - Materials / Optical materials - Materials / Plastics, polymers - Materials / Processes of production & treatment of materials - Materials / Photo-active & graphene-based materials - Energy and environmental sustainability - Health & Biotech

Description

The Proof-of-Concept A.L.I.C.E. or "Actuators based on Light sensitive CompositE" aims at the development of innovative materials through 3D/4D printing processes and uses them as actuators in the elds of photovoltaics, concentrated solar power, thermodynamic solar, and other applications such as optical deflectors, optical microvalves, and optical switches. The proposing teams, led by researcher Lucia Petti from the Institute of Applied Sciences and Intelligent Systems "Eduardo Caianiello" at the CNR in Pozzuoli and researcher Giuseppe Nenna from ENEA in Portici, downstream of the European FET OPEN PULSE-COM project, employ these materials and methods to develop a new generation of actuators that can be stimulated by UV-VIS and solar radiation. These specific actuators, when attached to solar cell, ensure that the sun is tracked in its movement throughout the day, continuously correcting its position and orientation, allowing for the accumulation of as much solar energy as possible to be converted into electrical energy. Indeed, the rays must always be perpendicular to the surface of the photovoltaic module to achieve maximum efficiency.

Type of innovation: Product innovation

Description of innovative features / Competitive advantages

The proposed multifunctional technology has the advantage of being high -performance, precise and at the same time eco-sustainable. Through necessary and adequate patent protection of the technology, the project aims to propose a new class of systems to revolutionize markets and change current paradigms in the eld of intelligent devices, robotics, sensors and actuators. Photomobile polymers represent radical innovation compared to competitors, both in terms of application to optical microvalves and for solar trackers. No company produces solar trackers whose movement does not depend on an electrical but solar stimulus (COMPETITIVE ADVANTAGE FOR A.L.I.C.E.). A.L.I.C.E., by developing a highly innovative material not currently present on the market, through its varied and skill-rich team, therefore holds the FIRST MOVER advantage for the application of photopolymers to small-sized Solar Trackers.

Reference market: Total innovation

Development stage: Prototype

TRL: 3, 4

Advantages: New product/process/service/technology

Patentable technology: No

Patented technology: Yes

Country/ies: Italy

Publication of technology: Published

Technology validation/demonstration: Internal validation

Market positioning: Italian, European, International

Partner required: Enterprise, Private research center, Seed capital, Cooperation in national /european / international project

Key words: Actuators, Photo-mobile polymers, Energy saving, Remote contact

Url: *https://promott.cnr.it/en/technology/244/alice-project-actuators-based-on-light-sensitivecomposite*

SPARK ANEMOMETRY FOR EFFICIENT AUTOMOTIVE PROPULSION

 # Record card: 245

Thematic areas

Automotive transport and logistics
Automotive transport and logistics / Innovative fuels
Automotive transport and logistics / Propulsion
Energy and environmental sustainability
Energy and environmental sustainability / Sensory
ICT & Electronics
ICT & Electronics / Electronics and microelectronics

Description

Spark anemometry based on the analysis of an electrical discharge can be implemented in the automotive sector through measurements of the secondary circuit voltage. Actual applicability of this method is quite limited, given that it requires additional hardware that is not compatible with space requirements specific for production engines (e.g. fueled with gasoline, LPG or methane); furthermore, applying high voltage measurements is complex and entails increased cost. This is the main reason why the existing spark anemometry method is limited to research applications. Instead, we are proposing a new technology that represents an alternative solution with contained cost but with the same effectiveness; it requires no additional hardware given that it is based on the characteristics of inductive ignition systems (already present in the vast majority of spark ignition engines).

More to the point, the proposed methodology features a starting point based on secondary current measurements (rather than secondary voltage) so as to estimate the in-cylinder fluid velocity around the spark plug during ignition. Even if it requires a calibration phase on a dedicated flow rig, the technology is completely non-invasive in terms of actual application on power units (with a wide range of displacement and configurations). In fact, once the coil and spark plug characteristics are defined, implementing the measurement is relatively straight forward, through the parameters identified during the calibration phase.

Innovation beyond the state-of-the-art is clear when considering that no additional hardware is required and the simple application on real-world systems; the most complex aspects of the methodology are related to the calibration phase.

Impact on actual applications can be identified through the possibility of defining optimal control strategies for various engine speed and load conditions, with ignition timing specifically adjusted for each cylinder. These control algorithms are based on the evaluation of fluid velocity close to the spark plug, with an emphasis on reducing cyclic variability. This approach allows significant efficiency increments, directly applicable on new or existing power units. The potential reduction of fuel consumption is even more noteworthy in “extreme” working conditions such as high levels of exhaust gas recirculation (EGR), lean fueling and the use of alternative fuels such as hydrogen.

Type of innovation: Product / process innovation in integration with an already existing technology

Description of innovative features / Competitive advantages Innovative aspects

- optimal ignition control tailored to actual in-cylinder conditions
- the technology does not require additional components for power units equipped with traditional ignition systems (i.e. inductive type)
- possible implementation of the control algorithm trough ECU software updates, therefore ensuring ample market potential
- completely compatible with standard ignition diagnostics
- fuel economy benefits are even more prominent in extreme conditions such as high levels of EGR, ultra-lean fueling and the use of alternative fuels such as hydrogen

Competitive edge

The technology offers significant competitive advantages in the reference automotive market; spark anemometry can also be applied on stationary engines, even if the off-road market can be heterogeneous to a high degree in terms of control methods. Given the current state of emerging technology, evaluating critical aspects is somewhat difficult and features high level of uncertainty. Nonetheless, two major bottlenecks were

identified for the automotive market. Implementing spark anemometry on new power units is limited by the willingness of the OEM to include it in the ECU. On the other hand, for existing engines, the end user plays an essential role; dedicated promotion actions that convey the main advantage of fuel economy benefits should ease implementation in the legacy fleet as well.
The only technology identified as a competitor at this stage is spark anemometry based on secondary voltage measurements; reduced applicability of this method is the main reason why it is not present on the market. The advantages of the proposed technology makes it possible to implement in-cylinder fluid measurements on a wide scale and to develop optimal control strategies aimed at improving fuel economy.

Reference market: Incremental innovation, Impacts on existing markets

Development stage: Feasibility

TRL: 2

Advantages: Product/process/service/technology optimization

Patentable technology: Yes

Patented technology: No

Technology validation/demonstration: Internal validation

Market positioning: Italian, European, International

Partner required: Enterprise, Public research center/university, Private research center, Seed capital, Cooperation in national /european / international project

Key words: Spark anenometry, Efficient power units, Ignition control, Alternative fuels

Url: *https://promott.cnr.it/en/technology/245/spark-anemometry-for-efficient-automotivepropulsion*

LARGE SCALE SYNTHESIS OF EARTH ABUNDANT NON-TOXIC SCALABLE PHOTOCATALYTIC SEMICONDUCTOR-PLASMONIC NANO HETEROSTRUCTURES

 # Record card: 246

Thematic areas

Materials - Materials / Photo-active & graphene-based materials

Chemicals & Physics - Chemicals & Physics / Sustainable substances and green chemistry

Energy and environmental sustainability - Energy and environmental sustainability / Pollution treatment (air, soil, water)

Description

Large-scale synthesis of inorganic colloidal TiO2@WO3-x nano heterostructures based on multicomponent semiconductor (TiO2)-plasmonic (WO3-x) heterojunctions. The syntheses of these nano heterostructures are realised in an aqueous environment using microwaves, an extremely efficient, fast, homogeneous and modular in core-localised dielectric heating mode in several simultaneous reaction vessels, which allows very fast synthesis times, high synthesis temperatures even in an aqueous environment and easy scalability. These nano heterostructures maximise the photochemical (and non-photochemical) mechanisms activated in the UV and VISNIR spectral range. They have proven to be of interest as active material in IR-selective electrochromic devices; photochromic material already tested in technical textiles;
chemiresistors for gas sensing and especially as photocatalysts in liquid-phase photooxidation reactions. The use of widely available and inexpensive chemical elements, water as the main reaction solvent, and the rapidity of synthesis frame the entire process in the fields of green chemistry and process sustainability.

Type of innovation: Product innovation

Description of innovative features / Competitive advantages

Large-scale (gram material) production by microwave technique of semiconductor-plasmonic TiO2@WO3-x nano-heterostructures with morphological and compositional control on a single heterostructure scale. Such heterostructured materials are attracting increasing interest in the scientific community, although they often require the presence of (rare and expensive) noble metals as plasmonic components. In contrast, the heterostructure discussed here utilises a common semiconductor in a non-stoichiometric form (WO3-x), which therefore takes on a metallic character. The nanostructures are generated in an aqueous environment, where they retain excellent colloidal stability, by means of a modular microwave system involving many dozens of parallel syntheses. This synthetic approach bypasses the conventional limitations of massive scaling-up, making the production of these photo-active 'nano-inks', which can be applied in diverse fields, more competitive. In addition, the possibility of functionalising large-area surfaces with wet and user-friendly techniques to produce nano-functionalised surfaces without geometry constraints is a further, not insignificant advantage.

Reference market: Incremental innovation

Development stage: Feasibility

TRL: 3

Advantages: New product/process/service/technology, Cost reduction

Patentable technology: No

Patented technology: No

Publication of technology: Published

Technology validation/demonstration: Internal validation

Market positioning: Italian, European, International

Partner required: Cooperation in national /european / international project

Key words: Colloidal inorganic nano-heterostructures, TiO2-WO3-x semiconductor-plasmonic nanomaterial, Microwave-synthesis, Hydroalcohothermal synthesis, Photocatalysis

Url: *https://promott.cnr.it/en/technology/246/large-scale-synthesis-of-earth-abundant-non-toxicscalable-photocatalytic*

BIOMATERIAL AND USE THEREOF IN THE TREATMENT OF LUNG PATHOLOGIES

 # Record card: 247

Thematic areas

Health & Biotech
Health & Biotech / New therapies
Materials
Materials / Composite and hybrid materials
Health & Biotech / Medical Device
Health & Biotech / Regenerative Medicine

Description

The present invention relates to the biomedical sector of the treatment of lung diseases and related symptoms. In particular, the present invention provides compositions and methods based on the use of selected polymeric biomaterials, in combination with stem cells and/or their secretome, capable of synergistically improving the development, regeneration and repair of chronic lung injuries and related symptoms. The present invention concerns a new biomaterial comprising: (a) hyaluronic acid having a molecular weight between 100 and 500 KDa; (b) collagen; (c) human mesenchymal cells and/or their secretome, and their use in the treatment of lung diseases, in particular chronic obstructive pulmonary disease (COPD), asthma, idiopathic pulmonary fibrosis (IPF) and pulmonary bronchodysplasia (BPD) of premature infants.

Type of innovation: Product / process innovation in integration with an already existing technology

Description of innovative features / Competitive advantages

Current pharmacological therapies for lung diseases only allow a palliative effect with a consequent lack of resolution of lung lesions. So far no one has proposed treating acute and chronic lung diseases with a single product, based on stem cells and/or their secretome and biomaterials, physiological constituents of the pulmonary extracellular matrix, such as collagen and hyaluronic acid, which have the ability to treat the symptoms and even reverse the injury of the lung tissues so as to halt the progression of the disease. Both adult and neonatal patients suffering from acute and chronic lung diseases such as chronic obstructive pulmonary disease (COPD), asthma, idiopathic pulmonary fibrosis (IPF) and pulmonary bronchodysplasia (BPD) of the premature newborn, SARS pneumonia could benefit from the medical device developed from this idea Covid 19. Furthermore, national and international industries involved in biomedical sectors could benefit from expanding their market.

Reference market: Incremental innovation

Development stage: Prototype

TRL: 4

Advantages: New product/process/service/technology, Product/process/service/technology optimization

Patentable technology: Yes

Patented technology: Yes

Country/ies: PCT

Technology validation/demonstration: Internal validation

Market positioning: Italian, European, International

Partner required: Enterprise, Private research center, Seed capital

Key words: Biomaterials, Hyaluronic acid, Collagen, Mesenchymal stem cells, Secretome, Therapy of lung diseases

Url: *https://promott.cnr.it/en/technology/247/biomaterial-and-use-thereof-in-the-treatment-of-lungpathologies*

IN VITRO TECHNOLOGY FOR BIOACTIVE COMPOUNDS PRODUCTION

 # Record card: 248

Thematic areas

Agrifood

Agrifood / Nutrition & health

Health & Biotech

Health & Biotech / Development of new drugs

Description

The technology based on cell or tissue cultures is very useful for the production of bioactive compounds. These molecules, depending on the class they belong to, can be used in the food, pharmaceutical and cosmetic industry. In particular, the developed technology is addressed to the optimization of bioactive compounds in plant cell/tissue cultures having the biosynthetic pathway of the compound of interest. Notably, the in vitro tissues developed are characterized by a high morphological and productive stability and represent a suitable material to grow in bioreactors. Moreover, these tissues can be treated with molecules that further induce the biosynthetic pathway of interest for obtaining larger amount of the compounds of interest.

Type of innovation: Product innovation, Process innovation

Description of innovative features / Competitive advantages

The innovative aspects of the developed technology are the following:

a) the obtained flax tissue cultures able to produce lignans such as Justicidin B with pharmacological properties not yet fully explored and proven in vivo. The innovation of this established technology is the obtainment of adventitious and hairy-roots from *Linum lewisii*, to date very little explored as a technological platform;
b) The Yield of justicidin B obtained by this technique is the highest recorded up to now.
c) Setting up and construction of an appropriate bioreactor able to support the growth of the plant tissues.
d) Set up of an elicitation technique capable of doubling the production of Justicidin B with respect to the normal growth condition.

Reference market: Impacts on existing markets, Creation of new markets

Development stage: Prototype

TRL: 4

Advantages: New product/process/service/technology, Cost reduction

Patentable technology: Yes

Patented technology: No

Technology validation/demonstration: Internal validation

Market positioning: Italian, European, International

Partner required: Enterprise, Public research center/university, Private research center, Seed capital, Cooperation in national /european / international project

Key words: Lignans, Linum lewisii, Adventitious roots, Hairy roots, bioreactors

Url: *https://promott.cnr.it/en/technology/248/in-vitro-technology-for-bioactive-compoundsproduction*

CRITICAL QUANTUM SENSOR

 # Record card: 249

Thematic areas

Chemicals & Physics

Chemicals & Physics / Micro and nanotechnology related to physical, chemical and exact sciences Chemicals & Physics / Quantum optics

Description

Our proposal consists in a quantum sensor based on a superconducting resonator. The working principle is based on the exponential growth of the susceptibility in proximity of a critical phase transition, where the system quickly switches from the vacuum state to a strong emission of easily detectable microwave signals, in response to extremely weak electromagnetic signals. The sensor can detect microwave and radiowave signals, with single-photon resolution. The device is operated under cryogenic refrigeration, and it can nd a variety of applications in the context of superconducting quantum technologies. In particular, the proposed device allows to: 1) readout the state of a quantum bit (qubit) with high fidelity and reducing the classical-electronic overhead; 2) Detect low-energy photons, with direct applications in the eld of quantum sensing, computation, communications, and cryptography, and with possible applications to quantum radars.

Type of innovation: Product innovation

Description of innovative features / Competitive advantages

The proposed device is based on a new concept, recently introduced in the research eld of quantum information. The working principle exploits quantum phase transitions that have been theoretically predicted and then experimentally observed in many-body atomic physics. The proponents of this device have transferred this concept to the technological framework of solid-state quantum circuits, where the theoretical idea can be put into practice using current technology.

The proposed device boasts two clear advantages: 1) Intrinsic resilience to external noise and thermal fluctuations, which represent the main limitation to the standard approach to quantum sensing; 2) a significant simplification of both the fabrication and the operation stages, as the sensor does not require the generation of complex quantum states and it minimizes the classical-electronics overhead.

Reference market: Total innovation, Creation of new markets

Development stage: Idea

TRL: 2

Advantages: New product/process/service/technology

Patentable technology: Yes

Patented technology: No

Publication of technology: No

Technology validation/demonstration: Internal validation

Market positioning: Italian, European, International

Partner required: Seed capital, Cooperation in national /european / international project

Key words: Quantum sensor, Quantum computing, Quantum technologies, Superconducting circuits, Radio magnetometry

Url: https://promott.cnr.it/en/technology/249/critical-quantum-sensor

IDENTIFICATION OF PHARMACOLOGICAL THERAPIES FOR THE TREATMENT OF BEHAVIORAL DEFECTS, MORPHOLOGICAL AND STRUCTURAL DEFECTS OBSERVED IN PATIENTS AFFECTED BY 22Q11.2 DELETION

 # Record card: 250

Thematic areas

Health & Biotech

Description

22q11.2DS(DGS) deletion syndrome is a rare and phenotypically variable multiorgan syndrome, currently without any cure. Our aim is to develop a standardized approach to formulate pharmacological products useful for clinical trials direct to prevent some serious clinical manifestations of adolescence and adulthood, such as neuropsychiatric and musculoskeletal diseases, or to eliminate or improve cardiovascular defects during embryonic development. Using animal models of 22q11.2DS we have already identified various molecules with known pharmacological characteristics and capable of improving cardiovascular and neurological development phenotypes, such as epigenetic drugs and vitamin B12. Our final goal is to create a cocktail of molecules or to identify at least more than one capable of recovering cardiovascular and neurocompartmental defects.

Type of innovation: Product innovation

Description of innovative features / Competitive advantages

The innovative aspect of the proposal consists in drug repositioning of drugs used for other pathologies but until now not related to the 22q11.2 DS deletion syndrome. These data can stimulate the interest of the pharmaceutical/pharmaceutical industry in the production of new formulations of already known drugs as well as for the production of a drug or a pharmacological cocktail, until now not known on the market, for the treatment of a rare multiorgan disease such as that caused by 22q11.2 DS deletion.

Reference market: Creation of new markets

Development stage: Feasibility

TRL: 3, 4

Advantages: Product/process/service/technology optimization

Patentable technology: No

Patented technology: No

Publication of technology: Published

Technology validation/demonstration: Internal validation

Market positioning: Italian, European, International

Partner required: Public research center/university, Private research center, Cooperation in national /european / international project

Key words: 22q11.2DS, Tbx1, Pharmacological therapy, Vitamina B12, Neurobehavioral impairments

Url: *https://promott.cnr.it/en/technology/250/identification-of-pharmacological-therapies-for-thetreatment-of-behavioral-defects*

EXECUTABLE QR CODES (EQR CODES)

 # Record card: 251

Thematic areas

ICT & Electronics - ICT & Electronics / Cybersecurity - ICT & Electronics / Smart cities and Communities - ICT & Electronics / Future Internet - ICT & Electronics / Robotics and control systems - ICT & Electronics / Augmented Reality - Additive and advanced industrial manufacturing - Health & Biotech - Health & Biotech / Smart Devices for Health and Wellness - Health & Biotech / Diagnostic, Medical imaging & advanced bioimaging - Health & Biotech / Medical Device - Health & Biotech / Diagnostic kits - Tourism, social sciences and cultural heritage - Tourism, social sciences and cultural heritage / Technologies for preservation of cultural heritage - Tourism, social sciences and cultural heritage / Education & learning - Tourism, social sciences and cultural heritage / Entertainment - Tourism, social sciences and cultural heritage / Tourism - Aerospace and Earth Science - Tourism, social sciences and cultural heritage / Socio-economic models - Tourism, social sciences and cultural heritage / Multimedia technologies Agrifood - Agrifood / Nutrition & health - Agrifood / Food quality & safety - Automotive transport and logistics - Chemicals & Physics - Energy and environmental sustainability - ICT & Electronics / Information processing, information system, workflow management - ICT & Electronics / IT and Telematics applications

ICT & Electronics / Multimedia

Description

The insertion of executable programs within QR codes is a new enabling technology for many application contexts in everyday life. Every time Internet access is unavailable, QR code usage is limited to reading the data it contains without any possibility of interaction. With the new eQR code technology, based on advanced techniques of formal languages and translators, it is possible to include highly compact executable programs within them, guaranteeing a remarkable level of interaction with the user, despite the strict limitations of QR codes in terms of storage capacity (max. 3 Kbytes).

An example of application that can benefit from the proposed technology is found in the context of Alpine routes, where eQR codes can be integrated in special signposts to guide the user in choosing the best route according to its own characteristics. Many other application contexts have been also identified.

Type of innovation: Product innovation, Service/know how innovation

Description of innovative features / Competitive advantages

Currently, eQR codes are the only existing technology that allows executable programs to be inserted within ordinary QR codes. Since the runnable code contained in eQR codes is customized to the specific application context, they represent both a valuable enabling technology and an exciting opportunity to embed intelligence within an object and make it interactively usable, even when the Internet is unavailable. For example, the network may be absent in isolated contexts like mountains, the sea, and developing countries, but also in hospitals and restaurants in cities such as Milan, where the shielding of buildings prevents optimal signal propagation. The CNR research group possesses the know-how to adapt eQR technology to new application contexts (concrete examples can be provided on request) while maintaining the main objective of minimizing QR code storage capacity.

Reference market: Incremental innovation

Development stage: Prototype

TRL: 4

Advantages: New product/process/service/technology

Patentable technology: No

Patented technology: No

Publication of technology: Published

Technology validation/demonstration: Internal validation

Market positioning: Italian, European, International

Partner required: Enterprise, Public research center/university, Private research center, Cooperation in national /european / international project

Key words: QR code, Executable QR codes eQR, User interaction, Intelligent objects, Internet of Things

Url: *https://promott.cnr.it/en/technology/251/executable-qr-codes-eqr-codes*

LIPID VESICLES FOR USE IN THE THERAPEUTIC TREATMENT OF AGGRESSIVE TUMORS

 # Record card: 252

Thematic areas

Health & Biotech
Health & Biotech / Micro and nanotechnology related to biological sciences
Health & Biotech / Bio-medicals
Health & Biotech / New therapies
Health & Biotech / Nanomedicine
Health & Biotech / Development of new drugs

Description

Extracellular vesicles produced by teratocarcinoma cells were isolated and characterized. Functional assays on glioblastoma (GBM) cell cultures showed the inhibitory effect of these vesicles on tumor cell migration, without inducing undesirable effects such as increased cell proliferation or chemotherapy resistance. The oncoprotein CRIPTO was found associated to teratocarcinoma-derived extracellular vesicles and related to the inhibitory effect on GBM cell migration. This finding is relevant for the development of a targeted therapeutic approach to limit the invasiveness and high infiltrative capacity of GBM, one of the main causes of tumor recurrence, and in perspective, the formation of metastases in other tumor types.

Type of innovation: Product innovation

Description of innovative features / Competitive advantages

1. Extracellular vesicles derived from tumor cell lines show natural antitumoral activity (inhibition of cell migration) per se, without engineering with therapeutic molecules.
2. The antimigratory activity was observed on glioblastoma (GBM) cells. The high invasiveness and infiltrative capacity of GBM underlies its high recurrence rate and poor prognosis, so the use of vesicles capable of recognizing GBM cells and inhibiting their migration is particularly relevant.
3. Identification of a protein, CRIPTO, associated with vesicles, implicated in the antimigratory effect observed. CRIPTO is a membrane-anchored as well as a soluble protein, so far associated with oncogenic functions. CRIPTO presence in vesicles could alter its mechanism of action and final effect on cells.

Reference market: Total innovation, Impacts on existing markets

Development stage: Feasibility

TRL: 3

Advantages: New product/process/service/technology

Patentable technology: Yes

Patented technology: Yes

Country/ies: Italy, PCT

Publication of technology: Published

Technology validation/demonstration: Internal validation

Market positioning: Italian, European, International

Partner required: Public research center/university, Private research center, Cooperation in national /european / international project

Key words: Lipid vesicles, Cancer therapy, Inhibition of cell migration, Cripto, Glioblastoma

Url: *https://promott.cnr.it/en/technology/252/lipid-vesicles-for-use-in-the-therapeutic-treatment-ofaggressive-tumors*

EDUCATIONAL KIT FOR NESTT (NARRATIVE AND EMOTIONAL SKILLS TRAINING WITH THYMIO)

 # Record card: 253

Thematic areas

Tourism, social sciences and cultural heritage / Technologies for preservation of cultural heritage Tourism, social sciences and cultural heritage / Education & learning

Description

Our innovative proposal involves an educational robotics training program, resulting from experimental research that combines traditional educational approaches with the utilization of robotics. Specifically, the educational robot Thymio, developed by EPFL, serves as a facilitator in the learning process to enhance School Readiness. To implement this program, we have designed an educational kit that currently includes 2 picture books, 6 nursery rhymes, 4 puzzles, 1 cartoon, 1 song, 6 podcasts, 1 command strip for robot commands, and 6 play mats depicting environments for testing the robot's actions. These materials have been meticulously designed for the educational program intended for children aged 4 to 6. The educational methodology is comprehensively explained in a guide tailored for professionals such as teachers, parents, and educators.

Type of innovation: Product / process innovation in integration with an already existing technology

Description of innovative features / Competitive advantages Educational Robotics:

- ✓ Didactic training designed to foster the development of soft and STEAM skills
- ✓ Utilizing Thymio's personification to encourage an emotional connection with the robot
- ✓ Incorporating varying numbers of robots into activities to enhance engagement

Teaching:

- ✓ Promoting training for teaching staff to ensure their proficiency in utilizing the program
- ✓ Extending the program's reach beyond the traditional classroom setting (i.e., homes)
- ✓ Encouraging collaboration between parents and educators through the shared use of kit resources

Learning:

- ✓ Integrating both traditional and innovative tools to ensure a well-rounded learning experience
- ✓ Intrinsic inclusivity and equity
- ✓ Designing the training specifically for young learners, following the scientific method

Rigorous research has validated the effectiveness and we are ready to partner with institutions/companies in the educational publishing sector, innovative services, and toy manufacturers to bring the transformative program to a wider audience.

Reference market: Impacts on existing markets

Development stage: Prototype

TRL: 5, 6, 7

Advantages: Product/process/service/technology optimization

Patentable technology: No

Patented technology: No

Publication of technology: Published

Technology validation/demonstration: External validation

Market positioning: Italian, European, International

Partner required: Enterprise, Public research center/university, Private research center, Cooperation in national /european / international project

Key words: Methodological protocol, Educational robotics, Preschool education, Educational kit

Url: *https://promott.cnr.it/en/technology/253/educational-kit-for-nestt-narrative-and-emotionalskills-training-with-thymio*

DIGITAL EYE FOR NON-DESTRUCTIVE AND CONTACTLESS QUALITY EVALUATION OF FRUIT AND VEGETABLES AT HARVEST AND DURING COLD CHAIN

 # Record card: 254

Thematic areas

Chemicals & Physics - Chemicals & Physics / Imaging & image processing - Agrifood - Agrifood / Food quality & safety - ICT & Electronics - ICT & Electronics / Internet of Things - Automotive transport and logistics - ICT & Electronics / Artificial Intelligence - Automotive transport and logistics / Logistics - Additive and advanced industrial manufacturing - Additive and advanced industrial manufacturing / Process control and logistic - Additive and advanced industrial manufacturing / Packaging - Measurement tools and Standards

Description

Digital Eye is an innovative, rapid and high-precision intelligent computer vision system for the nondestructive and contactless evaluation of quality and shelf-life of whole or fresh-cut fruit and vegetables. It integrates advanced vision and artificial intelligence technologies to estimate parameters useful to evaluate the quality of fruit and vegetables, during both the harvesting phase and the cold chain. Digital Eye uses a commercial RGB camera (AP3200TPGE (JAI Ltd., Yokohama, Japan) placed inside a commercial photographic box (HPB60D box, HAVOXR, Vendome, France) equipped with LED lighting and acquisition and image processing software developed in Matlab (MathWorks Inc., Natick, MA, USA). In addition to quality evaluation based on visible morphological traits, Digital Eye is able to assess some internal quality traits, associated to color variations induced during the storage by physiological processes that limit marketability. Digital Eye can analyze the quality of packaged ready-to-use fresh fruit and vegetables (fresh-cut) with performances similar to the ones on unpackaged products: a robust image segmentation technique identifies the areas in which the product is visible without the artefacts related to shadows or light reflections.

Type of innovation: Product / process innovation in integration with an already existing technology

Description of innovative features / Competitive advantages

Digital Eye provides an automatic, consistent, rapid, non-destructive, and contactless evaluation of the quality level (degree of freshness) of fruit and vegetables. The use of artificial intelligence minimizes the intervention of external operators during the design, configuration and starting phases. Digital Eye is scalable and applicable to other types of products through the training of models on new samples without modifying its architecture. It is flexible, resistant, easily transportable, and installable in the different working environments of the supply chain (laboratory, warehouse, retail, etc.). It is integrable with other software (for the logistics management of large-scale retail trade) or other Apps on smartphone or Internet of Things. It can evaluate useful parameters along the supply chain (e.g. nutritional values, storage time, level of freshness, level of browning, ammonia content, senescence indicators, maturation...).

Digital Eye can offer competitive advantages by enabling objective, coherent and pervasive control of products along the whole supply chain, from producers to final consumers. It can increase the final consumer satisfaction and a reduction in food losses and waste.

Reference market: Incremental innovation

Development stage: Prototype

TRL: 4

Advantages: Product/process/service/technology optimization

Patentable technology: No

Patented technology: No

Publication of technology: Published

Technology validation/demonstration: Internal validation

Market positioning: Italian, European, International

Partner required: Enterprise, Public research center/university, Private research center, Cooperation in national /european / international project

Key words: Non-destructive and contactless quality evaluation of fruit and vegetables, Nondestructive and contactless estimation of internal quality traits, Effectiveness on unpackaged and packaged products, Learning from examples, Simple, rapid and understandable machine learning algorithms and models

Url: *https://promott.cnr.it/en/technology/254/digital-eye-for-non-destructive-and-contactlessquality-evaluation-of-fruit-and*

NANOTERAPEUTICI INNOVATIVI A BASE DI CICLODESTRINE (NANOINCICLO)

 # Record card: 255

Thematic areas

Chemicals & Physics
Materials
Materials / Photo-active & graphene-based materials
Chemicals & Physics / Micro and nanotechnology related to physical, chemical and exact sciences
Health & Biotech
Health & Biotech / Smart Devices for Health and Wellness
Health & Biotech / Nanomedicine
Health & Biotech / Diagnostic, Medical imaging & advanced bioimaging
Health & Biotech / Development of new drugs
Chemicals & Physics / Sustainable substances and green chemistry
Health & Biotech / Medical Device

Description

NANOINCICLO is a technology based on the use of nanostructured cyclodextrins (CDs) for the targeted delivery of drugs such as anticancer drugs, photodynamic drugs, anti-inflammatories, antivirals, antibacterials, nutraceuticals and metals with therapeutic and diagnostic properties. Successful CDs for the proposed technology are FDA-approved or in advanced pre-clinical investigational stage and include natural and functionalized, polymeric, and amphiphilic monomeric CDs. These are powders of freeze-dried CDs or CDs films from solvent evaporation to be resuspended in the presence of the drug to be trapped in biologically relevant aqueous media. The proposed technology is extensively demonstrated for both hydrophilic and hydrophobic drugs. The trapping of the drug in the CD nanostructures is achieved through green preparations in water with the use of low percentages of organic solvents and allows the obtaining of highly homogeneous aqueous dispersions.

Type of innovation: Product / process innovation in integration with an already existing technology

Description of innovative features / Competitive advantages

The innovativeness of the proposal lies in the achievement of medical devices through a process that uses matrices and green methods such as CDs, aqueous media (superpure water, buffers and culture broths commonly used in biological assays) and small quantities of organic solvents. In addition, the process makes it possible to choose, through predictive computational theoretical studies, the suitable CD for the types of drug to be trapped. Ultimately, the technology makes it possible to engineer a multifunctional device that releases the drug at the site of action in a controlled and targeted manner.

Reference market: Incremental innovation, Impacts on existing markets

Development stage: Prototype

TRL: 4, 5

Advantages: Product/process/service/technology optimization

Patentable technology: No

Patented technology: No

Publication of technology: Published

Technology validation/demonstration: External validation

Market positioning: Italian, European, International

Partner required: Enterprise, Public research center/university, Private research center, Cooperation in national /european / international project

Key words: Drug delivery, Cyclodextrins, Greener Pharmaceuticals, Multifunctional Devices, precision medicine

Url: *https://promott.cnr.it/en/technology/255/nanoterapeutici-innovativi-a-base-di-ciclodestrinenanoinciclo*

WEMOS - WEARABLE ENVIRONMENTAL MONITORING SYSTEM

 # Record card: 256

Thematic areas

ICT & Electronics
ICT & Electronics / Sensor/multi-sensor technology, instrumentation
Energy and environmental sustainability
Energy and environmental sustainability / Sensory
Energy and environmental sustainability / Wearable technologies
Health & Biotech
Health & Biotech / Smart Devices for Health and Wellness
ICT & Electronics / Internet of Things
Tourism, social sciences and cultural heritage / Safety and security

Description

Environmental monitoring is a rapidly growing field, both in academia and industry. The use of wearables for environmental monitoring is a promising technique, as it allows data to be collected continuously and comprehensively. The main problem with using wearables for environmental monitoring is the size and weight of the system, as well as the high degree of specialization required to develop a fully functional device. WEMoS is an innovative wearable that solves these problems. It is a low-cost, open-source hardware, lightweight device that can measure four environmental factors: thermal, visual, air quality, and acoustics. WEMoS could have enormous potential, as it would allow monitoring of environmental conditions in workplaces, schools, or homes, and the collected data could be used to improve people's well-being and quality of life in general.

Type of innovation: Product / process innovation in integration with an already existing technology

Description of innovative features / Competitive advantages

Based on our knowledge, confirmed by a systematic review of the scientific literature (https://www.mdpi.com/1424-8220/21/14/4727), there is no wearable device that can measure all the environmental variables that allow us to comprehensively characterize Indoor/Outdoor Environmental Quality (IEQ or OEQ). To address this gap, we developed WEMoS. WEMoS is a device designed by researchers for researchers, which meets the specific needs of research aimed at the comprehensive characterization of the built environment's environmental quality. To reduce the cost and encourage widespread use, WEMoS is made using low-cost sensors, each of which has been carefully selected and tested to ensure maximum reliability. For the same reason, WEMoS is built using rapid prototyping techniques that use 3D printing and open-source hardware.

Reference market: Incremental innovation, Impacts on existing markets

Development stage: Prototype

TRL: 3, 4

Advantages: Product/process/service/technology optimization

Patentable technology: No

Patented technology: No

Publication of technology: Published

Technology validation/demonstration: External validation

Market positioning: Italian, European, International

Partner required: Enterprise, Public research center/university, Private research center, Cooperation in national /european / international project

Key words: Wearables, Monitoring, IEQ, OEQ, Internet of Things

Url: *https://promott.cnr.it/en/technology/256/wemos-wearable-environmental-monitoring-system*

MICROFLUIDIC SYNTHESIS OF ENGINEERED NANOPARTICLES

 # Record card: 257

Thematic areas

Chemicals & Physics

Chemicals & Physics / Micro and nanotechnology related to physical, chemical and exact sciences Chemicals & Physics / Inorganic substances

Description

Flow technologies for the synthesis of chemical intermediates have great potential at the industrial level and the synthesis of nanoparticles (NPs) can speed up the development of new products. In this context, we could find the technology for the synthesis of NPs. The NPs (Au, Ag, or Pt) are synthesized in a single step and are functionalized with polymeric stabilizers (such as PVP, PVA, PEG, or others) or with thio-glycosidic fragments. Synthesis proceeds through the injection of the precursor and ligand into a tubular reactor wrapped around a UV lighting system. During exposure to the light source (20 min to 2 hours), the precursor is photo-reduced and the stabilized NPs are formed. To purify and concentrate nanoparticles, simple centrifugation is used to remove and recover the unreacted linker. The colloidal solution that was obtained is a stable and homogeneous mixture of nanoparticles with a diameter of 2-4 nm, which can be used either as it is or freeze-dried without losing its morphological and chemical properties.

Type of innovation: Process innovation

Description of innovative features / Competitive advantages

The innovative features that this type of synthesis offers are many. Some characteristics are proper of the flow technology, such as high reproducibility, the ability to work continuously, the possibility of scale-up working in parallel, or the potential addition of any automated modules. Our synthetic pathway offers an alternative to batch processes and allows precise dimensional control in the ultra-small NPs size range. In addition, the synthesis proceeds without the use of co-solvents, toxic stabilizers, or chemical-reducing agents, obtaining a final product that requires a simple step of purification by centrifugation. The use of the UV photo-reduction system allows it to operate at room temperature and introduces an additional element of sustainability. The whole synthetic process can be easily performed in a sterile environment to obtain a final product with low biological contamination. The methodology (albeit behind further development) allows the synthesis of systems based on other noble metals such as silver and platinum.

Reference market: Incremental innovation

Development stage: Feasibility

TRL: 2, 3

Advantages: Product/process/service/technology optimization

Patentable technology: No

Patented technology: No

Publication of technology: Published

Technology validation/demonstration: Internal validation

Market positioning: Italian, European, International

Partner required: Cooperation in national /european / international project

Key words: Micro uidic, Nanoparticles, Nanomaterials, Gold, Engineered materials

Url: *https://promott.cnr.it/en/technology/257/micro uidic-synthesis-of-engineered-nanoparticles*

NEAR-INFRARED EMISSIVE LUMINESCENT MATERIALS, DEVICES, AND PROBES FOR OLED, AUTOMOTIVE, AND REMOTE-SENSING TECHNOLOGIES, AND AS INFRARED OPTICAL PROBES FOR BIOMEDICINE

 # Record card: 258

Thematic areas

Chemicals & Physics - Chemicals & Physics / Micro and nanotechnology related to physical, chemical and exact sciences - Health & Biotech - Health & Biotech / Diagnostic, Medical imaging & advanced bioimaging ICT & Electronics - ICT & Electronics / Optoacustic sensors, Optoelectronic devices - Health & Biotech / Medical Device - Energy and environmental sustainability - Energy and environmental sustainability / Environmental engineering/technologies - Chemicals & Physics / Inorganic substances - Energy and environmental sustainability / Sensory - Chemicals & Physics / Organic substances - Chemicals & Physics / Colours & dyes Materials

Description

The development of new materials with near-infrared emission (NIR, 700 – 1000 nm) represent an important target in the technological progress of innovative active components for OLED devices (including flexible ones), surveillance systems, autonomous driving, night vision sensors, fiber optic telecommunications and medical systems. In all these fields it still lacks a commercial NIR-OLED technology.

With the present invention we propose patented phosphorescent organometallic compounds (versatile materials useful for these purposes due to their excellent optical properties and thermal and chemical stability) with highly efficient NIR emission and synthesizable in largescale; we proved their suitability in optoelectronics developing a laboratory tested NIR-OLED prototype; a further use of these materials is in the fields of sensors and as NIR biological probes.

Type of innovation: Product / process innovation in integration with an already existing technology

Description of innovative features / Competitive advantages

The present technology exploits new organometallic complexes of Iridium and Platinum patented by the group, the method of preparation and their application in NIR-OLED.

Advantages: 1) New class of patented complexes with efficient phosphorescence between 700900 nm, excellent quantum yields of 10-15% and good thermal stability. 2) Reproducible and scalable synthetic procedures (gram scale preps). 3) The chemical structures are highly modulable and modifiable, allowing to obtain new derivatives in the future. 4) Easy processability for NIR-OLED production with solution deposition techniques (spin-coating, inkjet and roll-to-roll) and vapor deposition methods. 5) Production of NIR-OLED with low energy consumption also on flexible substrates. 6.Homogeneous luminous surfaces, lightweight and easy to integrate in the architectural and automotive sectors or in the aerospace, surveillance and defense sectors with paramount advantages over the classic commercial LED point emitters.

Reference market: Incremental innovation, Impacts on existing markets

Development stage: Prototype

TRL: 3, 4

Advantages: New product/process/service/technology

Patentable technology: Yes

Patented technology: Yes

Country/ies: Italy

Technology validation/demonstration: Internal validation

Market positioning: Italian, European, International

Partner required: Enterprise, Seed capital, Cooperation in national /european / international project

Key words: Near-infrared emitters, Cyclometalated complexes, OLEDs, Solution process, Optical probes

Url: *https://promott.cnr.it/en/technology/258/near-infrared-emissive-luminescent-materialsdevices-and-probes-for-oled-automotive*

NOVEL PROTEINS FOR HUMAN AND ANIMAL NUTRITION

 # Record card: 259

Thematic areas

Agrifood

Agrifood / Agriculture

Agrifood / Nutrition & health

Agrifood / Food quality & safety

Description

Design and testing of neoproteins with optimized nutritional value, according to needs, avoiding their degradation - thus maintaining a high production yield - and aggregation (which could make them indigestible). Neoproteins are produced and characterized in plant systems as bioreactors. We have already created zeolin, formed by the fusion of a bean seed protein with a portion of a maize seed protein. Zeolin has a more balanced essential amino acid composition than the two proteins of origin. We are studying further neoproteins, some based on the strategy used for zeolin, others based on different strategies. The results indicate that these neoproteins are produced in high amount in plant bioreactors.

This technology can be used for creating and producing any kind of protein or peptide for food purposes, or involved in food processing.

Type of innovation: Product innovation

Description of innovative features / Competitive advantages

Our technology can be exploited in the agri-food and nutraceutical sectors, by companies that produce foods which are marketed for particularly sensitive consumers. As example, the technology can be used to create hypoallergenic proteins, since some seed proteins widely used in the human diet are allergenic.

Furthermore, ad hoc designed food neoproteins can also be produced in plant cell culture bioreactors and, following extraction and purification, be part of formulation ingredients of the food of the future.

Reference market: Total innovation, Impacts on existing markets

Development stage: Feasibility

TRL: 4

Advantages: New product/process/service/technology

Patentable technology: Yes

Patented technology: No

Technology validation/demonstration: Internal validation

Market positioning: International

Partner required: Enterprise, Public research center/university, Private research center, Cooperation in national /european / international project

Key words: Protein engineering, Seed storage proteins, Human nutrition , Protein synthesis, Plant biotechnology

Url: *https://promott.cnr.it/en/technology/259/novel-proteins-for-human-and-animal-nutrition*

PLATFORM FOR THE IDENTIFICATION OF POTENTIAL ENDOCRINE DISRUPTOR AND CYTOTOXIC EFFECTS OF NATURAL AND SYNTHETIC COMPOUNDS

 # Record card: 260

Thematic areas

Agrifood - Agrifood / Nutrition & health - Agrifood / Food quality & safety - Health & Biotech - Health & Biotech / Development of new drugs Additive and advanced industrial manufacturing - Health & Biotech / Biosensors Health & Biotech / Bio-medicals - Chemicals & Physics - Additive and advanced industrial manufacturing / Packaging - Chemicals & Physics / Agro chemicals - Additive and advanced industrial manufacturing / Additive manufacturing processes and materials - Health & Biotech / Diagnostic kits - Chemicals & Physics / Colours & dyes - Chemicals & Physics / Plastics & rubber - Chemicals & Physics / Detergents & cleaning technologies

Description

The environment as well as the food production provide a number of both natural and synthetic compounds whose effects on human being as an organism have not yet been determined nor investigated. Moreover, routine analysis of the substances placed in the market evaluate basic macroscopic toxic effects such as extensive morphological changes and cell death, potentially underestimating the long-term consequence of chronic exposure to pollutants, as it happened with perfluoroalkyl and polyfluoroalkyl substances (PFAS) in the Italian Veneto region. In this context, our laboratory offers its consolidated experience, instrumentation, and methodologies, acquired through years of scientific research in the field, for the analysis of the potential negative effects on the endocrine system (i.e. as endocrine disruptors) and on cell and tissue homeostasis (more classical cytotoxicity) of molecules and compounds, which may be present in natural products as well as artificially synthetized and placed in the market. Thus, the technology we propose is of utmost relevance for companies working in the field of food production, pharmaceutics, nutraceutics, innovative materials, packaging, and food safety surveillance system. Indeed, it may provide a reliable and accurate pre-commercial study and scientifically relevant validation of the biological safety of substances before placing on the market.

Type of innovation: Service/know how innovation

Description of innovative features / Competitive advantages

The eventuality that objects of common use and food products might contain putative pollutants is an actual risk also as a consequence of the technological advance in material and food production of the present days. The knowledge and the capacity to monitor the potentially negative effects of any compounds coming to the market, to which we are exposed or even eat, is of utmost importance for the maintenance of our health and wellbeing. Our laboratory offers an innovative, scientifically validated, pipeline for the identification of putative endocrine disruptors present in the environment as well as in human products such textile, chemicals, pharmaceutics, food and food-related (for example, packaging). We propose the use of state-of-the-art biomedical research methodologies and instrumentations, together with innovative cellular models, in order to tackle possible harmfulness of existing molecules and substances or eventually to assess their biological-endocrinal neutrality. This approach represent the first line intervention for ensuring a production of materials and food in the total respect of human and environmental health, in line with a sustainable and safe future market development.

Reference market: Impacts on existing markets

Development stage: Prototype

TRL: 3, 4

Advantages: New product/process/service/technology, Product/process/service/technology optimization

Patented technology: No

Publication of technology: Published

Technology validation/demonstration: Internal validation

Market positioning: Italian, European, International

Partner required: Enterprise, Public research center/university, Private research center, Cooperation in national /european / international project

Key words: Endocrine disruptors, Pollutants, Endocrine system alteration, Synthetic molecules, Bioactive molecules

Url: *https://promott.cnr.it/en/technology/260/platform-for-the-identication-of-potential-endocrinedisruptor-and-cytotoxic*

METHODOLOGY FOR HORIZONTAL LEADERSHIP AND INTEGRATED ORGANIZATIONS (LOOI)

 # Record card: 261

Thematic areas

Tourism, social sciences and cultural heritage / Socio-economic models

Description

It enables a systemic and evolutionary development of people, organizations and territories by overcoming the criticality of traditional approaches, which get stuck because of rationalistic reductions in complexity, as well as lack of motivation. This responds to the social sustainability needs highlighted by the UN 2030 agenda. The methodology is based on 3 pillars:

1 evolutionary systemic view of the person;

2 evolutionary systemic vision of the organization/territory;

3 generation of a development pathway in which the two systems evolve synergistically; it takes the form of the creation of a "development infrastructure" consisting of a "community of directors" and a "community of developers" who will work at a set pace to explore the criticalities of the identity process (of the client/beneficiary), initiating experiments on improvements before going full steam ahead; the course includes the training of specific skills for evolutionary systemic development, called horizontal leadership skills, through transformational learning.

Type of innovation: Process innovation, Service/know how innovation

Description of innovative features / Competitive advantages

The methodology proposes several innovations that are in great demand on the market:

1 it boosts motivation, counteracts burnout and responsibly activates staff, optimizing work processes with respect to customer/beneficiary spillovers;

2 it generates a new framework of competences, defined as horizontal leadership, for reading and transforming contexts in a systemic and sustainable way; they respond to many market needs as transversal competences, as well as to what is required by the EU (learning to learn, spirit of initiative and entrepreneurship)

3 it innovates the approach to change in consulting and especially training, as it responds to the growing need for pathways that have an impact on work behavior and work processes, going beyond the mere learning of learners

4 it allows in practice a systemic and evolutionary development, of a holistic type, towards integrated organizations, as required by the international standard ISO 26000 on the Social Responsibility of Organizations and the requirements of social sustainability, also expressed in the UN 2030 agenda.

Reference market: Incremental innovation

Development stage: Industrialization

TRL: 7, 8

Advantages: New product/process/service/technology

Patentable technology: No

Patented technology: No

Publication of technology: Published

Technology validation/demonstration: External validation

Market positioning: Italian, European, International

Partner required: Enterprise, Public research center/university, Private research center, Cooperation in national /european / international project

Key words: Horizontal leadership skills, Transformative learning, Systemic evolutionary development, Integrated organizations

Url: *https://promott.cnr.it/en/technology/261/methodology-for-horizontal-leadership-andintegrated-organizations-looi*

METHOD FOR IDENTIFICATION AND ASSESSMENT OF ANTIGEN-SPECIFIC CD4+ T LYMPHOCYTES ACTIVATION IN CELIAC DISEASE. G.A.T.CD4 (GLIADIN-ACTIVATED CD4+ T CELLS)

 # Record card: 262

Thematic areas

Health & Biotech

Health & Biotech / Bio-medicals

Health & Biotech / Diagnostic kits

Agrifood

Agrifood / Nutrition & health

Description

The proposal concerns the development of the G.A.T.CD4 (Gliadin-activated CD4+ T cells) method which allows, in peripheral blood, the identification of CD4+ T lymphocytes reactive to toxic peptides of gliadin, the main gluten protein of cereals. Through the use of specific markers of CD4+ T lymphocytes activation, the G.A.T.CD4 method allows the frequency and reactivity of antigen-specific T helper lymphocytes in a blood sample, following antigen stimulation and subsequent analysis with multiparametric flow cytometry. The test is based on the preparation of the leukocyte fraction (PBMC) from a venous sampling, cells culture in plates in the presence of the antigenic gliadin peptides pool or the entire deamidated gliadin protein. After 48 hours of incubation, only the CD4 T lymphocytes specific for the gliadin antigen will be activated and proliferate and can be stained with a cocktail of 4 monoclonal antibodies and analyzed by flow cytometry. The test will be positive only in patients suffering from celiac disease acute, and will be negative for those patients who are in remission of the disease, on a gluten-free diet.

Type of innovation: Product innovation

Description of innovative features / Competitive advantages

The diagnosis of celiac disease is carried out by determining the titre of anti-transgutaminase and anti-endomysial antibodies in the blood. In controversial cases, for which it is not possible to make a diagnosis on the basis of antibodies and clinical symptoms, gastroscopy with biopsy is performed. The method G.A.T.CD4 aims to the identification of CD4+ T lymphocytes reactive towards gluten, a widely consumed food protein and responsible for one of the most common forms of food intolerance globally. The applications of the G.A.T.CD4 method are:

1. Diagnosis of acute celiac disease without histopathological analysis of intestinal mucosa ltissue (EGDS examination or esophagogastroduodenoscopy).
2. Support for the diagnosis of active celiac disease in doubtful cases of EGDS.
3. Monitoring of disease remission following the gluten-free diet.
4. Support for research in order to analyze the phenotype and functions of subpopulations of pathogenic CD4+ T lymphocytes, reactive to gliadin.

Reference market: Impacts on existing markets

Development stage: Prototype

TRL: 4

Advantages: New product/process/service/technology

Patented technology: Yes

Country/ies: Italy

Technology validation/demonstration: Internal validation

Market positioning: Italian, European, International

Partner required: Enterprise, Seed capital

Key words: Diagnostic kit, Celiac disease, CD4 T cells, Flow cytometry, Marker of cell activation, Gliadin-specific CD4 Lymphocytes

Url: *https://promott.cnr.it/en/technology/262/method-for-identication-and-assessment-ofantigen-specific-cd4-t-lymphocytes*

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