



Kemijski inštitut  
Ljubljana  
Slovenija

PATENTS & TECHNOLOGIES

*Where*  
the Future is Born

**10** APPLICATIONS AT  
THE EUROPEAN  
PATENT OFFICE

**5** SOLD  
PATENTS

IN THE **PAST THREE YEARS ALONE**, THE NATIONAL INSTITUTE OF CHEMISTRY HAS APPLIED FOR MORE THAN 40 PATENTS, WHICH PLACES IT AT THE TOP OF THE SLOVENIAN ORGANIZATIONS THAT APPLY FOR PATENTS. OF THOSE:

- 16 Slovenian applications,
- 13 PCT applications,
- 5 sold patents,\*
- 10 applications at the European patent office and
- foreign national applications (USA, Austria and Japan)

**13** PTC  
APPLICATIONS

**16** SLOVENIAN  
APPLICATIONS

FOREIGN NATIONAL APPLICATIONS  
(USA, AUSTRIA AND JAPAN)

\*(the most successful of those is the water-soluble form of the Q10 coenzyme)

## PRESENTED PATENTS

THE ENVIRONMENTALLY FRIENDLY, HIGH YIELD PRODUCTION OF NANOCELLULOSE FROM NATURAL SOURCES

CELL-BASED DEVICE FOR LOCAL TREATMENT WITH THERAPEUTIC PROTEINS

NEW ELECTROCATALYST BASED ON CUXPTY ALLOYS WITH AN ARRANGED STRUCTURE

COLOURED MULTILAYER COATINGS EXHIBITING LOW SOLAR ABSORBANCE AND HIGH THERMAL EMITTANCE

CHEMICALLY-MODIFIED REDUCED GRAPHENE OXIDE AS A SEPARATOR MATERIAL IN SULPHUR-CONTAINING BATTERIES

A PROCESS FOR THE PREPARATION OF SELF-CLEANING WASHING-RESISTANT COTTON TEXTILES

DIRECTED BIOSYNTHESIS BY COMBINING BIOSYNTHETIC ENZYMES ON MOTIFS OF NUCLEOTIDE SEQUENCE

SELF-ASSEMBLED PROTEIN NANOSTRUCTURES

TEMPERATURE INDICATOR FOR SHOWING THE TEMPERATURE FLUCTUATION OF ARTICLES ABOVE THE PRESCRIBED LIMIT IN THE COLD CHAIN

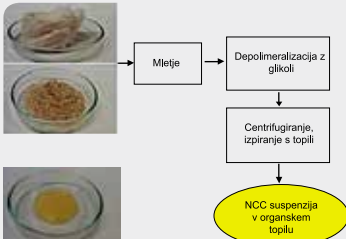
CATALYST AND THE PROCESS FOR CONVERTING GAS MIXTURES OF METHANE AND CARBON DIOXIDE INTO SYNGAS





# THE ENVIRONMENTALLY FRIENDLY, HIGH YIELD PRODUCTION OF NANOCELLULOSE FROM NATURAL SOURCES

CURRENTLY, NANOCRYSTALLINE CELLULOSE IS PREPARED USING ENERGY DEMANDING AND ENVIRONMENTALLY UNFRIENDLY PROCESSES, THUS THE NEW PROCESS IS THAT MUCH MORE IMPORTANT AND REPRESENTS AN EXCEPTIONAL OPPORTUNITY FOR THE ENTERPRISE SECTOR.



Nanocellulose, which is a biodegradable natural material, has exceptional mechanical properties. It is used as a reinforcement in polymer composites, as a carrier of medicinal substances, in the paper and in the coating industry. The invention describes an environmentally friendly, cost-efficient production process for technologically undemanding technology. The international assessment of the patent application (PCT) has assessed the process as innovative and useful for the industry. The Slovenian wood industry (and others) now has the opportunity to overtake all the competition that engages in the production of nanocellulose.

## ADVANTAGES/NOVELTIES

- Environmentally friendly, cost-efficient nanocellulose production process.
- Opportunity for economic growth in the wood processing industry.

## RESEARCH TEAM

- dr. Matjaž Kunaver
- dr. Tomaž Kos
- dr. Alojz Anžlovar
- dr. Ema Žagar
- dr. Miroslav Huskič

## COOPERATION TYPE

R&R cooperation, technology licencing

**Application**  
in the wood processing industry

## STATE OF THE ART

Patent

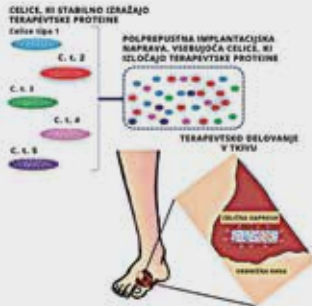
## INTELLECTUAL PROPERTY

Slovenian patent: 24656



# CELL-BASED DEVICE FOR LOCAL TREATMENT WITH THERAPEUTIC PROTEINS

A THERAPEUTIC DEVICE WITH THERAPEUTIC CELLS THAT SECRETE A COMBINATION OF THERAPEUTIC PROTEINS.



The therapeutic cells are stored in a semi-permeable chamber that enables the exchange of nutritional substances and therapeutic proteins. The therapeutic device is useful for various therapeutic purposes, such as the treatment of chronic wounds and neurodegenerative diseases. Stem cell therapy is one of the approaches to the challenges of regenerative medicine, but the therapy has a series of difficulties, thus the idea of the inventors to replace stem cells with therapeutic cells that secrete biologically active molecules is an important step towards a safer and cost effective therapy.

## ADVANTAGES/NOVELTIES

- Replacing the stem cells when treating chronic wounds and neurodegenerative diseases.
- The effective elimination of a series of issues accompanying stem cell therapy.

## RESEARCH TEAM

- Lucija Kadunc
- Duško Lainšček
- Simon Horvat
- Roman Jerala
- Iva Hafner Bratkovič

## COOPERATION TYPE

R&R cooperation, technology licencing

**APPLICATION**  
In health care

## STATE OF THE ART

Patent

## INTELLECTUAL PROPERTY

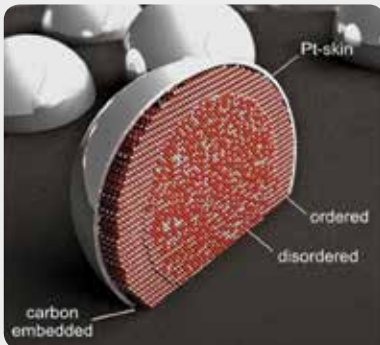
PCT/SI2014/000050



## NEW ELECTROCATALYST BASED ON $Cu_xPt_y$ ALLOYS WITH AN ARRANGED STRUCTURE

THE INVENTION INVOLVES THE SYNTHESIS OF PLATINUM ALLOYS WITH TRANSITION ELEMENTS (MAINLY COPPER), WHICH CAN BE USED AS A CATALYST IN FUEL CELLS.

The new materials show an up to 5 times higher catalytic effectiveness for the reduction of oxygen compared to pure platinum and are at the same time much cheaper. The process according to the invention enables the preparation of several 10-gram catalyst quantities and is thus suitable for direct use at the industrial level.



### ADVANTAGES/NOVELTIES

- Improved catalytic activity for oxygen reduction and certain other reactions.
- A lower price than existing catalysts on the market.

### RESEARCH TEAM

- Dr. Marjan Bele (National Institute of Chemistry)
- Dr. Miran Gaberšček (National Institute of Chemistry)
- Gregor Kapun (National Institute of Chemistry)
- Dr. Nejc Hodnik (National Institute of Chemistry)
- Dr. Stanko Hočevar (National Institute of Chemistry, Mebius)

### COOPERATION TYPE

Technology licensing

### APPLICATION

The catalyst's potential use is in all electronic applications where platinum catalysts are currently being used.

### STATE OF THE ART

Possible synthesis and use on the industrial scale

### INTELLECTUAL PROPERTY

US 9, 147, 885 B2

Co-ownership: MEBIUS, d. o. o.



# COLOURED MULTILAYER COATINGS EXHIBITING LOW SOLAR ABSORBANCE AND HIGH THERMAL EMITTANCE

## THE INVENTION APPLIES TO::

- coloured multilayer coatings exhibiting low solar absorbance and high thermal emittance that can be used for adjusting the maximum temperature of coated surfaces exposed to direct sunlight,
- the procedure for applying the coating and
- cold surfaces prepared with the application of such coatings.

The compositions for colour coatings are made by mixing highly reflective metal or metalized flakes, for IR transparent or IR reflective pigments in various binding substances; and their high thermal emittance is ensured with the application of a transparent high thermal emittance top layer. The coatings can be applied by spraying or with the coil coating procedure.

## ADVANTAGES/NOVELTIES

- High thermal emittance of coatings.
- Improved procedure for applying coatings.

## RESEARCH TEAM

- Boris Orel
- Matjaž Koželj
- Ivan Jerman
- Mohor Mihelčič
- Helena Spreizer
- Lidija Slemenik Perše

## COOPERATION TYPE

R&R cooperation, technology licencing



**APPLICATION**  
in making coatings for outdoor applications

## STATE OF THE ART

Patent

## INTELLECTUAL PROPERTY

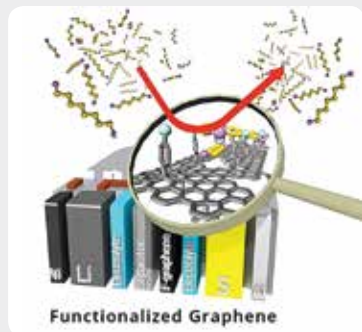
Slovenski patent: 23451



# CHEMICALLY-MODIFIED REDUCED GRAPHENE OXIDE AS A SEPARATOR MATERIAL IN SULPHUR-CONTAINING BATTERIES

**THE INVENTION REPRESENTS THE USE OF A NEW TYPE OF GRAPHENE MATERIAL THAT SHOWS GOOD PROPERTIES AS A SEPARATOR IN BATTERIES CONTAINING SULPHUR AND BATTERIES CONTAINING SULPHUR COMPOUNDS.**

The separator can be an independent membrane containing chemically modified reduced graphene oxide or a layer of graphene material on the surface of classic separators in modern batteries. The preferred chemical modification enables the hydrophobic properties of graphene, which prevents the diffusion of sulphur compounds from the positive electrode into the negative electrode.



## ADVANTAGES/NOVELTIES

- Greater stability of Li-S-batteries.
- Better utilization ratio between the input and received electric power.

## RESEARCH TEAM

- Alen Vižintin
- dr. Boštjan Genorio
- prof. dr. Miran Gaberšček
- dr. Robert Dominko

## COOPERATION TYPE

R&R cooperation, technology licencing

## APPLICATION

In modern batteries, mainly lithium-sulphur batteries

## STATE OF THE ART

Laboratory research

## INTELLECTUAL PROPERTY

Slovenian patent: 24590

Co-ownership: CO NOT, Centre of Excellence for Low Carbon Technology



# A PROCESS FOR THE PREPARATION OF SELF-CLEANING WASHING-RESISTANT COTTON TEXTILES

**THE INVENTION IS A PROCESS FOR THE PREPARATION OF SELF-CLEANING WASHING-RESISTANT AND AIR PERMEABLE SUPERHYDROPHOBIC AND OLEOPHOBIC COTTON TEXTILES.**

High contact angle and washing resistance can be achieved for cotton textiles by providing a suitable micro- and nano-roughness, as well as with suitable crosslinking with the use of hydrophobic and oleophobic organically modified silane precursors.



## ADVANTAGES/NOVELTIES

- Improved washing resistance properties of cotton textiles.
- High contact angle for water and hexadecane even after repeated washings.

## RESEARCH TEAM

- Milena Zorko, MSc (National Institute of Chemistry)
- Dr. Barbara Simončič (University of Ljubljana, Faculty of Natural Sciences and Engineering)
- Jelena Vasiljević (University of Ljubljana, Faculty of Natural Sciences and Engineering)
- Dr. Brigita Tomšič (University of Ljubljana, Faculty of Natural Sciences and Engineering)
- Dr. Ivan Jerman (National Institute of Chemistry)
- Dr. Miran Gaberšček (National Institute of Chemistry)

## COOPERATION TYPE

R&R cooperation, technology licencing

## APPLICATION

The technology is suitable for textiles intended for making protective working clothing, as well as clothing for sports and leisure, since it retains air permeability, superhydrophobic and oleophobic properties and the appearance of the textiles.

## STATE OF THE ART

Prototype

## INTELLECTUAL PROPERTY

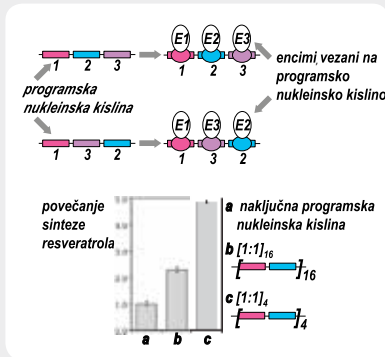
Slovenian patent application no. P-201400289

Co-ownership: Faculty of Natural Sciences and Engineering Ljubljana



# DIRECTED BIOSYNTHESIS BY COMBINING BIOSYNTHETIC ENZYMES ON MOTIFS OF NUCLEOTIDE SEQUENCE

THE INVENTION APPLIES TO THE PRINCIPLE OF IMPROVING THE SYNTHESIS OF BIOPRODUCTS USING BACTERIA.



The forced joining of enzymes that form the biosynthetic path is done via a program nucleic acid. In this way, enzyme active aggregates are created within cells. Experimentally, we have proven the principle by synthesizing resveratrol using bacteria and also published our findings after applying for patent (Conrado et al, Nucl. Acid Res 2012).

## ADVANTAGES/NOVELTIES

- The invention provides for the implementation of a program nucleic acid and enzymes that bind to the program nucleic acid into a production organism.
- The program nucleic acid determines the position and number of individual enzymes in the active aggregate. The formed enzyme aggregate enables an improved utilization of the synthesis of the chosen bioproduct.

## RESEARCH TEAM

Roman Jerala, Mojca Benčina, Monika Avbelj, Tomaž Koprivnjak, Irena Vovk, Rok Gaber, Tina Lebar, Gregor Anderluh, Jerneja Mori, Jernej Turnšek, Tina Ilc, Nejc Tomšič, Tjaša Stosicki, Matej Žnidarič, Jure Bordon, Mattia Petroni, Vesna Glavnik

## COOPERATION TYPE

R&R cooperation, technology licencing

## APPLICATION

The strategy is suitable for improving the synthesis of various bioproducts using bacteria. The advantage of active enzyme aggregates is especially evident in the synthesis of bioproducts with biosynthetic-path-forming enzymes that originate from various organisms and that, with the help of anchoring to the program nucleic acid, are brought closer to other enzymes.

## STATE OF THE ART

Prototype

## INTELLECTUAL PROPERTY

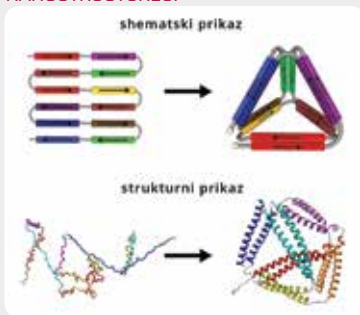
Austrian patent: AT512453

Co-ownership: EN-FIST Centre of Excellence



# SELF-ASSEMBLED PROTEIN NANOSTRUCTURES

THIS INVENTION APPLIES TO A NEW TECHNOLOGY WITH THE HELP OF WHICH IT IS POSSIBLE TO PLAN POLYPEPTIDE CHAINS WHICH, BY SELF-ASSEMBLY, FORM PROTEIN NANOSTRUCTURES.



Polypeptides are assembled modularly from linked peptide segments that in pairs form coils and thus the side of a polyhedron. Experimentally, we have proven the principle by making a tetrahedron structure of nanodimensions and also published our findings after applying for a patent (Gradišar et al, Nature Chem. Biol. 2013).

## ADVANTAGES/NOVELTIES

- The invention makes it possible to design new protein structures not found in nature, and the input of selected functions into positions with nanometre resolution, which makes it possible to **prepare technologically interesting advanced nanomaterials.**
- Protein nanomaterials have numerous advantages compared to nanomaterials from organic or inorganic building blocks.

## RESEARCH TEAM

- prof. dr. Roman Jerala
- dr. Helena Gradišar
- Sabina Božič Abram
- Tibor Doles

## COOPERATION TYPE

R&R cooperation, technology licencing

## APPLICATION

The strategy is suitable for preparing protein nanostructures that can be functionalized for various medicinal (vaccines, drug supply) and other technological purposes (biocatalysis sensors, the input of recognizable places, optical, electrical and mechanical properties).

## STATE OF THE ART

Prototype

## INTELLECTUAL PROPERTY

Slovenian patent application: P-201100402

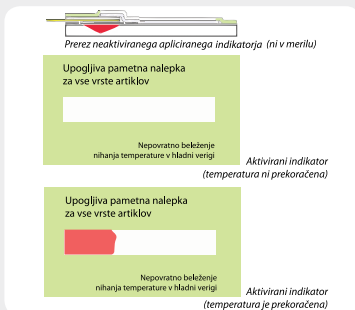
Co-ownership: EN-FIST Centre of Excellence



# TEMPERATURE INDICATOR FOR SHOWING THE TEMPERATURE FLUCTUATIONS OF ARTICLES ABOVE THE PRESCRIBED LIMIT IN THE COLD CHAIN

THE INVENTION INVOLVES THE DETECTION OF THE TEMPERATURE FLUCTUATION VIA THE UPPER OR PRESCRIBED TEMPERATURE FOR MAINTAINING THE ITEMS IN THE COLD CHAIN.

The temperature indicator operates via chemical and physical changes of the indicator material and thus does not need a power supply. The recorded information is readable under all circumstances that enable visual or video detection.



The indicator irreversibly records the time of exceeding the predetermined temperature, which is lower than room temperature. When using on items in a cold chain, it also provides information about safety and quality (e.g. animal food).

## ADVANTAGES/NOVELTIES

- The indicator is entirely feasible with a combination of processes for graphic technology.
- The tank design for the indicator material enables precise dosing and the repeatability of all indicator versions.
- Flexible material carriers enable the use of the indicator on any form of packaging.

## RESEARCH TEAM

- dr. Marta Klanjšek Gunde
- dr. Metka Hojzeri
- Kristina Bašneč (CETIS)

## COOPERATION TYPE

R&R cooperation, technology licencing

## APPLICATION

Control of transport and/or warehousing of products or substances with properties that are significantly dependent on temperature and the time the allowed temperature was exceeded which is lower than room temperature.

## STATE OF THE ART

Prototype

## INTELLECTUAL PROPERTY

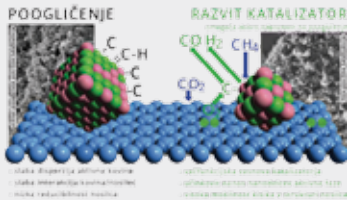
Slovenian patent application: P-201500277

Co-ownership: CETIS, d. d.



# CATALYST AND THE PROCESS FOR CONVERTING GAS MIXTURES OF METHANE AND CARBON DIOXIDE INTO SYNGAS

THE ADVANCE DESIGN OF A COST EFFECTIVE CATALYST ENABLES OPERATION IN MILD REACTION CONDITIONS WHILE ACHIEVING HIGH ACTIVITY, STABLE LONG-TERM OPERATION AND THE ABSENCE OF CARBONISATION OF CATALYST SURFACE.



This invention enables the effective conversion of natural gas with an additional source of carbon dioxide or the direct conversion of biogas obtained from renewable sources and various biologically degradable waste.

## ADVANTAGES/NOVELTIES

- A cost effective catalyst for converting methane and carbon dioxide into syngas (mixture of H<sub>2</sub> and CO).
- The effective conversion of natural gas with an additional source of carbon dioxide or a direct biogas conversion.

## RESEARCH TEAM

- Ilja Gasan Osojnik Črničev
- Peter Djinović
- Boštjan Erjavec
- Albin Pintar

## COOPERATION TYPE

R&R cooperation, technology licencing

## APPLICATION

In the production of biofuel and other chemicals with high added value

## STATE OF THE ART

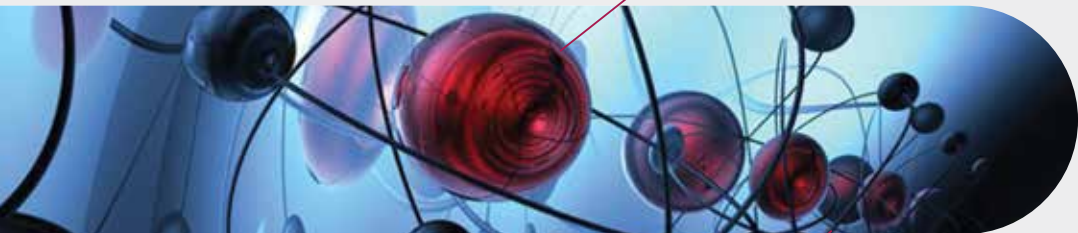
Patent

## INTELLECTUAL PROPERTY

EP14468002.2

WE CURRENTLY  
HAVE

33 Slovenian  
patents



17 valid  
international  
patents

## VALID SLOVENIAN PATENTS

NO. PATENT	PATENT DESCRIPTION
22256	Mutated Truncated mt-pfka GENE for Synthetizing an Active Shorter Fragment of the 6-Phosphofructo-1-Kinase
22407	Utilizing the Q10 Co-Enzyme for a More Effective Animal Breeding and Production of Animal Tissue with Increased Content of the Co-Enzyme
22771	Titanites of Transition Metals as Materials for Cathode in Lithium Batteries
22859	The Steric Stabilized Dispersion of Hybrid Inorganic-Organic Material in Oil as a Formulation for Protection against UV-Rays and Preparation Process
22883	Vaccines that Combine Antigen and Toll-like Receptors
23087	Electrode Composite Based on Redox Active Organic Molecules as an Electrode Amterial in Lithium-Ion Batteries

23155	Cathode Materials for Lithium-Ion Batteries based on Lithium Vanadium Oxide Compounds
23183	Self-Assembled Structures Made from a Single Polypeptide Chain of at least Three Segments that can Form Coils
23292	Process for Preparing Polyhedral Silsesquioxanes
23451	Coloured Multilayer Coatings Exhibiting Low Solar Absorbance and High Thermal Emittance
23488	Two-Stage Synthesis Method for Preparing Composites of Insertion Active Substances for Lithium Ion Batteries
23508	Fusion Polypeptide Composed of a TIR Domain and Dimerisation Domain for Modulation of Signals TLR/Natural Immunity
23510	Improved Synthesis of the Product of Biosynthesis with the Directed Assembly of Biosynthetic Enzymes on the Motif of Nucleotide Sequence
23578	The Characterization of Complex Structural Mixtures G-quadruplexes
23669	A Novel and Compact Reactor System for Processing and Reutilizing Sanitary Waste Water
23670	Asphalt with Added PMMA/ATH
23800	Compact and Multi-function Reactor System for Eliminating Nitrate Ion Substances from Groundwater
23833	New P-Chiral Phosphorous Compounds, Their Catalysts and Use in Enantioselective Analysis
23902	Self-Assembled Polypeptide Polyhedra
24049	Aliphatic Polyesteramide Dendrimeres
24056	Insert for Tub for the Horizontal Unfolding of Chromatographic Plates
24095	Process for Processing Brewery Leavening Agents into Biogas
24110	With N-heterocyclic Carbene Facilitated Preparation of Polyhedral Silsesquioxanes
24111	With PMMA/ATH Composite Powder Modified Bitumen and its Application
24177	Bistable Toggle Gene Switch with a Pair of Cross Repressors and a Positive Loopback based on DNA binding Proteins
24317	New Carboxamide Inhibitors of the MurD Enz
24426	Procedure for Preparing Zeolite ZSM-5-Granulates without an Inorganic Binder
24444	Gage for a Battery's State of Charge in a Converted Electrical Vehicle
24474	DNA Binding Proteins, the Function of which Depends on Cyclization
24484	Calibration Process for Controllers with Motors
24590	Chemically-Modified Reduced Graphene Oxide as a Separator Material in Sulphur-Containing Batteries
24656	Method for Making Nanocrystalline Cellulose
24684	Process for Preparing Alpha-Hydroxyphosphonates from Unsaturated Phosphonate Parent Compounds with Regioselective Hydroboration



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