Podklady pro habilitační a jmenovací řízení (přehled projektů a grantů)

Uchazeč: **M.Sc. Rafael Omar Torres Mendieta, Ph.D.**

Podpis:

Hodnocené období: 2018-2023

1. Jmenovaný člen řešit. týmu zahr. výzk. Grantu

1) Czech Member of Committee COST project CA19123 - Protection, Resilience, Rehabilitation of damaged environment, 21/09/2020 - 20/09/2024

Working Groups: 2. Bio-Electrochemical Systems to reduce the environmental impact of pollutants and bioresource valorization

Contribution: My contribution to the PHOENIX action lies in exploring the use of laser micromachining to enhance exoelectrogen biofilm growth over anodes in microbial fuel cells. My involvement is framed in working group 2, working task 4; functionalized electrodes in bioelectrochemical systems.

Description: Humanity faces unprecedented challenges: global warming, overuse of fossil fuel energy and rapidly growing urbanisation. While the development, validation and cost-efficiency improvement of energy-aware and limited-complexity solutions are becoming increasingly time-consuming, microorganisms represent one realistic hope. For millennia microbes have tirelessly been shaping the Earth's ecosystems and with the right approach, they can help re-introduce environmental equilibrium. PHOENIX aims to demonstrate the effectiveness of Bio-electrochemical systems (BESs); BESs are low environmental impact systems that exploit the biological activity of live organisms for pollutant reduction, recycling of useful elements, synthesis of new products and production of electricity, in the case of microbial fuel cells (MFC). Recent advances in the field of low power electronics enable the exploitation of these sustainable and environmentally-friendly technologies. The activities of PHOENIX will be related to the characterization of BESs technologies and their implementation as bio-remediator, bio-sensors, and bio-reactors connected to sustainable urban planning, educational and socio-economic aspects. The integration of bio-technologies in the urban context is a key priority for appropriate rational urban planning and minimum environmental impact.

Status: Running Project

https://www.cost.eu/actions/CA19123/#tabs+Name:Description

2. Jmenovaný člen řešit. týmu českého výzk. Grantu

1) LO1201 - ROZVOJ ÚSTAVU PRO NANOMATERIÁLY, POKROČILÉ TECHNOLOGIE A INOVACE TECHNICKÉ UNIVERZITY V LIBERC, 25/05/2017 – 31/12/2018.

Position: Researcher.

Description: The main objective of the project is to support the use of newly constructed research infrastructure – university workplace CxI, its new building, newly purchased equipment and created research teams of high quality. The realization of the CxI++ project that is being put forward will significantly contribute to effective usage of this infrastructure, its stability, long-term sustainability and further systematic guided development while keeping the set up structures of the expert profile of the university Center. The CxI workplace has developed a line of fine relationships with external partners from public and private spheres of industrial practice. The subject of the submitted CxI++ project is a complex of seven research themes of the CxI university workplace. Themes which presume research, development and innovative activities were chosen for the complex. All the themes suggested for financing in the CxI++ project being put forward to the NPU I program develop a certain specialization, moving the state of knowledge and technology forward, while having a high potential for valuable output, contributing to the ability of Czech research and industry to compete globally. The complex of seven themes labeled T1-T7 submitted for financing is not coherent from the technical point of view, but rather each of the themes included are fully intact with the professional profile of the project implementation of one of the two research programs of either Competitive engineering or Material research, which were described in detail in the corresponding project financed within the framework of Operational Program Research and Development for Innovation. Stabilizing the research environment of the CxI workplace will also strengthen the collaboration in research and development inside the TUL. The CxI workplace as a whole will therefore reinforce its interdisciplinary abilities and allow new impulse, incentive and access coming from the TUL faculties.

Status: Project concluded with outstanding results.

https://www.isvavai.cz/cep?s=jednoduche-vyhledavani&ss=detail&n=0&h=LO1201

2) CZ.02.1.01/0.0/0.0/16_019/0000843 - HYBRID MATERIALS FOR HIERARCHIC STRUCTURES, 01/01/2018 – 31/12/2022.

Position: Senior Researcher.

Description: The aim of the project is to support interdisciplinary problem-oriented material research which will dramatically improve the efficient use of Technical University of Liberec's R&D activities, leading to internationally compatible quality of research. The R&D research intent is divided into three mutually linked research programmes: Flexible hierarchical structures, Composite materials and structures, and Functionalized nanomaterials. The sub-objectives, the development of interdisciplinary teams, relation with international research partners and equipment will lead to new results and joint projects.

Status: Project concluded with outstanding results.

https://www.isvavai.cz/cep?s=jednoduche-vyhledavani&ss=detail&n=0&h=EF16_019%2F0000843

3) SGS-2020-4053 - FEMTO-MEMBRANE: Příprava nanoslitin pomocí femtosekundových laserových pulzů za účelem vylepšení membrán pro separaci olej/voda, 01/02/2020 – 31/12/2020.

Position: Senior Researcher and Advisor of the student for whom the project was granted.

Description: A laser-mediated strategy will be used to synthesize PVDF nanofiber-based membranes decorated with TiAg nanoalloys. The synthesized material will be further used for the recovery and purification of water from oily polluted sources. It is expected that the inherent properties of the nanoalloy components will improve the membrane by providing antibacterial properties, hydrophilicity, surface charge change, and degradation of water-polluting compounds. Differently from alternative nanoalloy synthesis strategies, the methodology proposed in the current project, ie the simultaneous processes of pulsed laser ablation in liquids and the photoreduction of nanoparticle-precursor molecules, promises to effectively produce the required material while the production of chemical waste is greatly suppressed ; an issue that outshines the ecological benefit behind the oil/water separation sector while traditional nanoparticle synthesis pathways are used. Therefore, the current project could bring a huge move forward in both, expanding the knowledge about the laser-mediated synthesis of nanostructures, and the low environmental impact design of tailored solutions for the oily polluted water treatment.

Status: Funding stopped due to Faculty's limited budget.

https://www.fp.tul.cz/images/fakulta/AS/podklady/Zprva_o_hospodaen_FP_2020.pdf

4) LTAUSA18078 - Studium rolí ferátů a modifikovaného nanoželeza v aktivačním procesu persulfátů, 01/06/2019 – 30/06/2022.

Position: Senior Researcher.

Description: Persulfates are one of the newest oxidants that are used in in situ chemical oxidation. Although persulfates chemistry has been researched for some years, there are still many unknowns that should be investigated. The broader impacts of this joint project will include, but will not be limited to, creation (1) of new approaches for persulfates activation [with the iron in various oxidation states (modified nano zero-valent iron and ferrates)] and use of thus activated persulfates for remediation of toxic organic and inorganic substances e.g. organic contaminants that are on the list of persistent organic pollutants, (2) of a novel way for determination of persulfates that will be developed and protected during the project timebeing. The created method will be facile and fast and will allow for detection of persulfates in a double oxidant system (e.g. persulfates and ferrates) and will be required for evaluation of the persulfates reaction kinetics in the researched matrices. In the long term, this joint project will further a broader synergistic coupling between US and Czech researchers in the persulfates and nanomaterial domain by bringing new collaborators and facilitating new international links between the researchers and students in related areas at multiple institutions.

Status: Project concluded with outstanding results.

https://www.isvavai.cz/cep?s=jednoduche-vyhledavani&ss=detail&n=0&h=LTAUSA18078

5) LTAUSA19091 - Porézní biologické 2D membrány a 3D struktury vystavěné z polysacharidů funkcionalizovaných rostlinných gum a jejich environmentální aplikace, 01/01/2020 – 31/12/2022.

Position: Senior Researcher.

Description: The proposed project aims to develop ultra lightweight, high-strength, bio-based, biodegradable, porous, and tuneable two-dimensional (2D) membranes and three-dimensional (3D) sponges with facile synthetic schemes based on eco-friendly polysaccharide gums. The proposed 3D sponges and 2D porous membranes will be fabricated via self-assembly-freeze-drying, cryogelation and electrospinning from tree gum exudates (eg arabic, karaya, tragacanth, ghatti, and kondagogu) as well as their blends with other renewable natural/ synthetic biodegradable polymers. The enhancement of functional properties (physicochemical, mechanical, thermal, hydrophobicity/hydrophilicity and surface area) will be investigated by applying the environmentally friendly “green technologies” such as plasma treatment, laser ablation, γ-ray irradiation, UV initiation and microwave treatment. Furthermore, the hierarchical porous structure and functional groups of gum will be used for functionalization of porous membranes and sponges with various metal/metal oxide or core-shell nanoparticles, and other organic/polymeric molecules. The ensuing porous functionalized structures will form an integral part of applications for sustainable development under the umbrella of green chemistry and technology, specifically heterogeneous catalysis (greener catalytic degradation) and extraction of environmental contaminants of various types (heavy metals, pesticides, and organic dyes). and other organic/polymeric molecules. The ensuing porous functionalized structures will form an integral part of applications for sustainable development under the umbrella of green chemistry and technology, specifically heterogeneous catalysis (greener catalytic degradation) and extraction of environmental contaminants of various types (heavy metals, pesticides, and organic dyes). and other organic/polymeric molecules. The ensuing porous functionalized structures will form an integral part of applications for sustainable development under the umbrella of green chemistry and technology, specifically heterogeneous catalysis (greener catalytic degradation) and extraction of environmental contaminants of various types (heavy metals, pesticides, and organic dyes).

Status: Project concluded with outstanding results.

https://www.isvavai.cz/cep?s=jednoduche-vyhledavani&ss=detail&n=0&h=LTAUSA19091

6) LM2018124 - Nanomateriály a nanotechnologie pro ochranu životního prostředí a udržitelnou budoucnost, 01/01/2020 – 31/12/2022.

Position: Senior Researcher.

Description: The main objective of the Research Infrastructure NanoEnviCz (RI) is creation of the efficient platform both for the partners of the project as well as for the external users. The RI will primary aim at the development and preparation of high-performance and conceptually innovative nanostructured materials for sustainable future with particular interest in the development of novel technologies for the protection and remediation of the environment. RI will offer services in the fields of heterogenous catalysis for environmental protection, technologies for renewable energy resources and storage, nanotechnology for trapping and chemical degradation of pollutants and technologies for sensing and monitoring of pollutants. The development of new nanotechnology will always undergo objective assessment not only the benefits but also potential risks that may be associated with nanomaterials.

Status: Project granted an extension due to outstanding results.

https://www.isvavai.cz/cep?s=jednoduche-vyhledavani&ss=detail&n=0&h=LM2018124

7) SGS-2022-3008 - LANDAU-WATER: Laserem sestavené recyklovatelné nanokatalyzátory k degradaci antibiotik nežádoucích ve vodních systémech, 01/02/2022 – 31/12/2023.

Position: Senior Researcher and Advisor of the student for whom the project was granted.

Description: The current project aims to generate magnetic photocatalysts to degrade antibiotics found in water bodies, such as sulfamethoxazole (SMX). This will be done by synthesizing Bi-based magnetic nanoalloys through Reactive Laser Ablation in Liquids (RLAL); a recently explored synthesis approach that promises to fine-tune the physicochemical properties of nanoalloys. Furthermore, since the catalytic behavior of these nanoalloys will be powered by visible light, their employment as magnetically-recyclable degradation agents will offer a sustainable solution towards removing antibiotics from water. The removal of these polluting agents will help combat the empowerment of antibiotic-resistant bacteria by limiting their prolonged exposure to antibiotics; thus, their strategies to evolve into superbugs – one of the incoming biggest threats for mankind.

Status: Running Project.

https://www.fm.tul.cz/veda-a-vyzkum/studentska-grantova-soutez/sgs-2022

8) 101079345 - SURRI: Sustainable Remediation Of Radionuclide Impacts On Land And Critical Materials Recovery, 01/01/2023 – 31/12/2025.

Position: Senior Researcher and Working Package Leader.

Description: Radioactive contamination of the environment including soil and groundwater is not uncommon since there are numerous sources of radionuclides from human activities, including defence-related, power production, medical, industrial and research activities. The contamination poses a long-term hazard to human and environmental health. Remediation of contaminated soil layers with various conventional physical and chemical treatments is difficult and expensive. The EU-funded SURRI project will investigate sustainable electrochemical and microbiological interventions enabling improved remediation while recovering materials resources including rare earth elements from radionuclide-impacted waste. This will be done in the context of a twinning programme to strengthen the capacity of the Technical University of Liberec in Czechia.

Status: Running Project.

https://cordis.europa.eu/project/id/101079345

3. Projekty budou předloženy v roce 2023

1) Modification of nanofibrous membranes combined with energy recovery to enhance anti-biofouling capability in wastewater treatment processes, 01/01/2024 – 31/12/2027.

Position: Leading partner.

Goals: The main objective is to develop and test polymeric nanofibrous membranes decorated by different nanoalloys for wastewater treatment. These novel materials will be characterized by high anit-biofouling capacity in the environment enabling energy recovery.

Project call: International grant projects (LA) GAČR.

2) Lignin nanofibers as separators of electron transfer in supercapacitors, 01/01/2024 – 31/12/2026.

Position: Team member.

Goals: The main objective is to develop highly conductive and catalyst electrodes based on carbon nanofibrous layers containing different inorganic nanoparticles. The electrodes will be employed as separators and electron transfer devices in supercapacitors. Since the project considers the preparation of carbon nanofibers from lignin, and laser-mediated strategies will be employed to produce the nanoparticles, it is expected that the solution of the current project will be of wide interest to incorporate “green” practices to the development of supercapacitors and fuel cell components.

Project call: Standard grant project GAČR.