

Topic: SC1-BHC-07-2019: Regenerative medicine: from new insights to new applications (RIA)

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Deadline: 16th April 2019

Description of the offered expertise

CEITEC (Central European Institute of Technology) is a multidisciplinary scientific centre in Brno, Czech Republic, acting in the fields of life sciences, advanced materials and technologies with the primary focus on interactions between life and materials sciences. The main expertise of CEITEC team for project proposal in this H2020 call is research and development of advanced biomaterials and approaches in biological chemistry for applications in medicine. Development of materials and their characterisation is supported by a unique scientific infrastructure.

The research topics related to the current call include:

- Synthesis and applications of nanomaterials in medicine, e.g. nanoparticles, microparticles (spheres, rods, whiskers, plates, etc.) and encapsulations, modification and bonding of (bio)active substances having specific function, elemental particles as potential antimicrobials, etc.
- Development of customized functional scaffolds as carriers for a broad range of cell and bioactive substance based on bioceramics, biopolymers, nanocomposites and hydrogels. These structures are created directly from computer-generated models, thus improving current scaffold design by controlling scaffold parameters (such as pore size, porosity, and pore distribution) as well as by incorporating an artificial vascular system to supply oxygen and nutrients deep into the scaffold. Novel biomaterials are being developed with the hierarchical structure controlled on length scales ranging from nanometers to implant sizes. Technologies producing clinically relevant scaffolds with suitable properties and biological functions are being developed for bone tissue and cartilage reconstructive surgery, as delivery vehicles in various cell therapies, for controlled delivery of biological substances, as novel resorbable injectable bone adhesives, or wound healing dressings.
- A part of the research is also devoted to development and fabrication of various sensors based on nanotechnologies. Technologies to integrate systems such as thin-film and MEMS technologies are mostly used for devices development, also packaging, biocompatible housing, wire-bonding, and integration using microtechnologies are commonly employed.

Description of potential role

In this call we can offer research work in the following areas:

1. **Synthesis of nanomaterials and nanostructures (nanoparticles, semiconductor nanocrystal, etc.):** Nanomaterials such as magnetic nanoparticles (MNPs) can be employed as an effective and versatile tool for isolation of analytes (nucleic acids, proteins, etc.) to improve significantly their detectability and simplify the process of analyte identification. Other synthesized nanomaterials could be nanoparticles based on selenium and other metals and semi-metals having wide-spectrum antimicrobial effects on the one hand, but no or only minor cytotoxic effect on eukaryotic cells on the other.
2. **Preparation and physico-chemical and biological characterizations of nanostructured hierarchical biomaterials (scaffolds) suitable for regeneration of both soft and hard tissues, drug delivery, or substrates for cell behavior evaluation:** Biomaterials can be synthesized and prepared with modern technologies including additive manufacturing of a novel polymers (biopolymers, hydrogels), ceramics (calcium phosphates) and polymer/ceramic composites with controlled life-time and we can offer 3D bio-printing of suspensions including its modification with specific biologically active substances in micro and nanosizes.

3. **Preparation of biosensors:** We can develop electrochemical and immunological biosensors for continuous non-invasive tissue monitoring during *in vivo* healing. Namely, biological and chemical sensors for detection of biomarkers and physical parameters of healing (diagnostic sensors) as well as sensors with theranostic functions. The sensors can be equipped with wireless technology, which will facilitate data transfer and allow on-line measurement and can be integrated with suitable scaffolds and biomaterials.

Reference to previous successful projects, products, patents and market applications

Recent and current ongoing projects awarded by European Commission include:

- 2017: H2020-SMEInst-2016-2017, “Selenmast“
- 2018–2022: ERC-2017-STG, “ToMeTuM”
- 2017–2020: H2020-GALILEO-GSA-2017, “GreenPatrol“
- 2017–2018: H2020-WIDESPREAD-04-2017-TeamingPhase1, “Back4Future”
- 2016–2019: H2020- ECSEL-RIA, “ASTONISH”
- 2015–2017: H2020-JTI-IMI2-2014-02-single, “FILODIAG“
- 2009–2013: 7 FP ENIAC JU, “MAS”

Current ongoing projects awarded by Czech Ministry of Health and Czech grant agencies closely connected to the call:

- 2018–2021: NV18-05-00379: Development and comprehensive evaluation of novel injectable, resorbable, porous bone substitute with controlled release of antimicrobial agents
- 2017–2020: 17-31276A: Comprehensive pre-clinical evaluation of lateral lumbar spine fusion with hybrid biodegradable nanocomposite porous implant.
- 2017–2020: 17-29874A: Optimization of nanostructured dermal substitutes in animal model
- 2008–2012: Miniaturized intelligent systems and nanostructured electrodes for chemical, biological, and pharmaceutical applications
- 2008–2012: New design and exploiting nanobiosensors and nanosensors to target medicine

European patents:

- Vojtová, L.; Michlovská, L.; Jančář, J.: Biologically degradable hydrogel with controlled lifetime and method of preparation thereof. Applicant: Vysoké učení technické v Brně, European Patent Office, Germany. EP 3097134 (B1), 2017-07-19.
- Vojtová, L.; Jančář, J.; Method of preparation of thermodegradable polyurethane foams. Applicant: Vysoké učení technické v Brně, European Patent Office, Germany, EP 2370487 (B1), 2013-03-06.

National patents:

- Hubalek, J., Kizek, R., Adam, V., Ryvolova, M., Provaznik, I.: Two-dimensional protocol for the separation of biologically important substances and their rapid identification, 2012/108, 2012. Thanks to the obtained patent, an active collaboration has been established with the company Agilent, developer of bioanalysers.
- Kopel, P., Adam, V., Hubalek, J., Kizek, R. Method for the preparation of nanoparticles of apoferritin with a closed antitumor drug, 2012-956, 2012. Developed particles are now being tested in a large preclinical study.
- Adam, V., Chudobova, D., Cihalova, K., Kizek, R., Kopel, P., Melichar, L., Ruttkay-Nedecky, B.: Preparing nanocomposite selenium nanoparticles anchored in biopolymer substance such as hyaluronic acid, collagen or chitosan to improve antimicrobial and biocompatible properties and healthcare used in modified medical material. 2015-62937U, 2015. The patent is actively used and has become the basis for a commercially available product called Selenbact.
- Vojtová, L.; Michlovská, L.; Oborná, J.; Jančář, J.; Vávrová, M.: Biologically degradable hydrogel with controlled service life and process for preparing thereof. CZ 305137 (B6), 2015.