CEIPEX BUT TOPIC 17

Položka / Field	Obsah / Content
CEIPEX RESEARCH TOPIC LEVEL 1	Advanced Materials
CEIPEX RESEARCH TOPIC LEVEL 2	Advanced Biomaterials
NAME OF THE RESEARCH GROUP	Advanced Biomaterials
SUPERVISOR	Assoc. Prof. Lucy Vojtová, Ph.D.
POTENTIAL CO-SUPERVISOR	Abolfazl Heydari, Ph.D.
PROPOSED RESEARCH TOPIC TITLE	3D Bioprinting of Hierarchical Osteochondral Constructs for Integrated Bone and Cartilage Regeneration
RESEARCH TOPIC DESCRIPTION	Osteochondral defects remain a major challenge in regenerative medicine due to the complex hierarchical organization of articular cartilage, the cartilage-bone interface and subchondral bone. The proposed project should focus on the development of patient-specific, 3D-printed and/or bioprinted hierarchical constructs capable of supporting integrated regeneration of the entire osteochondral unit. A key concept will be the creation of a zonal osteochondral architecture comprising: (i) a cartilage zone supporting chondrogenesis and cartilage-specific extracellular matrix formation, (ii) an intermediate interface zone mimicking the transition between cartilage and bone, and (iii) a subchondral bone zone providing mechanical support and promoting osteogenesis and mineralized tissue formation. The project may explore innovative combinations of cell-laden bioinks, hydrogels, bioactive polymers, ceramics or composite materials, together with spatial gradients in composition, architecture, mechanical properties, cells and/or bioactive signals. Advanced 3D printing and bioprinting strategies should enable controlled integration of the individual zones into a single patient-specific construct. The developed constructs should be evaluated in terms of printability, structural and mechanical properties, degradation, cytocompatibility and tissue-specific biological performance. The ultimate goal is to develop a hierarchical osteochondral construct suitable for preclinical in vivo evaluation in an osteochondral defect model, targeting simultaneous cartilage repair, subchondral bone regeneration and integration with the surrounding native tissue. The project provides flexibility for the applicant to propose an original biomaterial and biofabrication strategy toward personalized and translational osteochondral regeneration.
KEYWORDS	Hierarchical biomaterials, osteochondral defects, cartilage, 3D bioprinting, 3D printed bone, patient-specific implants
INTERDISCIPLINARY DIMENSION	Link to Biophotonic groups - study of cell-matrix interaction in in vitro bioimaging laboratory using confocal and holographic microscopes, CEITEC NANO+ core facility - the use of different equipments like SEM, rheometer, tensile machines, GPC/MALS, FTIR, Raman spectroscopy etc.
WEBPAGE OF THE RESEARCH GROUP	https://www.ceitec.eu/advanced-biomaterials/rg317