POPULAR SCIENCE SUMMARY OF THE PROJECT

The interest in the topic of personalized bone implants stems from the fact that the number of bone implantations has increased exponentially in recent years, as they are the second most transplanted tissue in the human body after blood (in 2021, the global market for orthopedic implants was estimated at $67 billion, and it is expected to exceed $88 billion by 2027). The increase in implantation procedures is related to both the growth of the aging global population and, consequently, the increase of orthopedic injuries or diseases, as well as the progressive change in lifestyle toward an active lifestyle. Also of great importance is the development of biochemical and physical methods to meet individual patient needs through the design and manufacture of customized implants. Of particular importance in this context are the appropriate selection of the material used to manufacture the implant and the causal effects between the composition and structure of porous bone scaffolds and their therapeutic ability and their ability to form/mimic bone. The determined properties of the interactions at the level of nanostructures between biological and physical systems can be used to understand the functioning of e.g. biological sensors, to understand the adverse processes around the intervention site that take place during the contact of the implant with components of body fluids (e.g. blood plasma), to design optimal surfaces of bone implants or to design and synthesize drugs.

The research project is part of the above topics related to the development and execution of basic research on repetitive, porous (with specific pore dimensions, defined pore geometry, high-degree of pore interconnection), bifunctional, biomimetic three-dimensional (3D) bone scaffolds (P3BS) in terms of mechanical strength, (P3BS) in terms of mechanical strength, environmental resistance, and ability to form bone, repair large bone defects caused by human cancers and surgical removal of bone) and to determine their therapeutic capabilities, which consist in the destruction of cancer cells in a specific area by inducing their programmed death (apoptosis). In other words, the main goal of the project is to demonstrate the causal effects between the composition and structure of porous, bifunctional, 3D biomimetic bone scaffolds and their ability to form/mimic bone and support cancer treatment.

The research proposed in this project fits perfectly into the priority research areas (POB) "Civilization Diseases, New drugs, and Regenerative Medicine" and "Advanced Material Technologies" ("National Program for Scientific Research", Annex to Decision No. 164/2011 of August 16, 2012, Council of Ministers).