BIOSCA

**Cold Atmospheric Plasma-Assisted Fabrication of Multifunctional Biodegradable Scaffolds with Enhanced Bioactivity and 3D Printability (BIOSCA)**

**Project Objective:** The main objective of the project is to develop, optimize, and validate a method for producing biocompatible and biodegradable nanocomposite scaffolds using atmospheric cold plasma technology and 3D printing based on stereolithography (SLA) (Fig. 1).

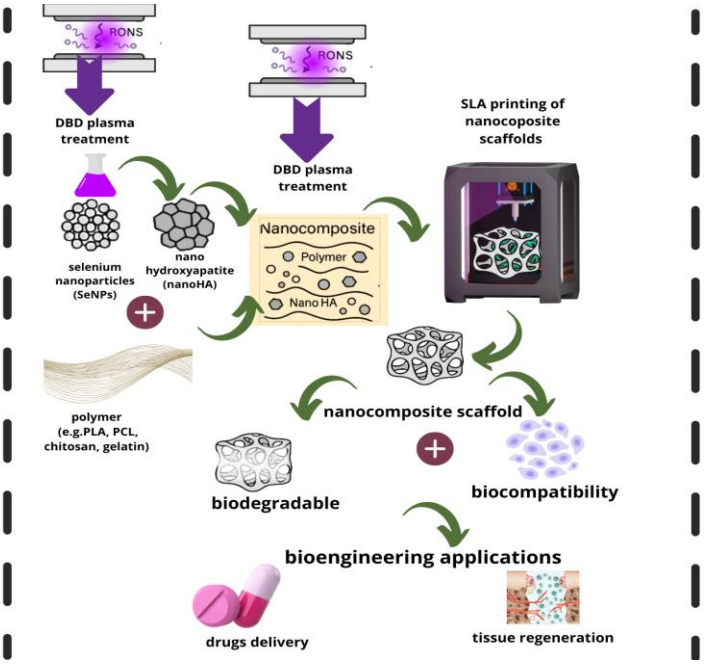


**Figure 1. General objective of the project.**

**Research Description:** In the first stage of the project, a one-step synthesis of selenium nanoparticles (SeNPs) and nanohydroxyapatite (nanoHA) will be conducted using cold atmospheric plasma, generated as a result of dielectric barrier discharge (DBD) ignition. The obtained nanoparticles will then be characterized in terms of granulometric properties. In the next stage, dispersion of the nanoparticles as an aerosol in polymer matrices (*e.g.,* chitosan or gelatin) is planned. The prepared nanocomposites will be treated with cold atmospheric plasma. Afterwards, their granulometric and mechanical properties will be estimated. The synthesized nanocomposites will serve as material for scaffold fabrication using SLA-3D technology. The final stage will involve assessing the biocompatibility (including cell adhesion), biodegradability, and mechanical properties (*e.g.,* strength and surface roughness) of the scaffolds. Validation of the developed method will be performed based on all obtained data.

**Rationale for the Project:** Modern bioengineering increasingly utilizes nanomaterials, appreciating their biocompatibility, controlled structure, and physicochemical properties conducive to integration with human tissues. However, creating materials that are simultaneously biodegradable, biocompatible, and do not provoke inflammatory responses after implantation remains a significant challenge. Moreover, a method is needed that limits the amount of reagents used, accelerates scaffold production time, thereby reducing environmental impact and lowering production costs. The BIOSCA project addresses these needs by proposing an innovative method of obtaining nanocomposites using cold atmospheric plasma technology.

**The most important outcomes** of the project will be: 1) the development, optimization, and validation of a method for producing biocompatible and biodegradable scaffolds, in addition to 2) deep understanding of physicochemical mechanisms accompanying plasma processes, leading to fabrication of scaffolds of defined properties. The results of this project will provide a foundation for future applications in regenerative medicine and tissue bioengineering.