

**PhD Proposal 2025**

**ANR Project 3DP-ARBio - 3D Printed Advanced Regenerative Biomaterials**

**Title:** Biocompatibility, kinetics of cell colonization and biodegradability of 3D printed polymeric bone scaffolds

**Description:**

Bone scaffolds are temporary structures designed to support the repair of damaged bone. These structures must be biocompatible and promote stem cell migration and differentiation into specialized cells. Once the bone is repaired, the scaffold should degrade safely, without releasing toxic agents, in order to avoid secondary surgery for its removal. For this reason, bioresorbable polymers are particularly sought after. Although various polymers have been developed, a major challenge remains in combining suitable materials with appropriate scaffold geometries, while balancing cell behavior, tissue growth, mechanical performance, and biodegradability. The 3DP-ARBio project (https://anr.fr/Project-ANR-24-CE51-2151) was launched to address this challenge, bringing together four French research groups with complementary expertise. This PhD thesis will be carried out at URCA (BIOS Laboratory) and will focus on experimental studies of stem cell colonization within different 3D-printed scaffolds. Key parameters to be evaluated include cell adhesion and colonization kinetics, biocompatibility, and scaffold biodegradation. The resulting data will be integrated into mathematical models for the design of improved bone scaffolds, in collaboration with CentraleSupélec. The scaffolds will be produced by partner groups using different polymers, geometries, and 3D printing techniques. Once obtained, the PhD candidate will conduct a series of biological evaluations. First, cytotoxicity and cell morphology will be analyzed using scanning electron microscopy and laser scanning confocal microscopy. Several cell types relevant to the implantation site will be tested, including mesenchymal stem cells, osteoblasts, endothelial cells, CD14+ monocytes, osteoclasts, and macrophages. Next, cell adhesion and colonization kinetics, along with scaffold degradation, will be investigated using a custom-designed bioreactor. Finally, scaffold biodegradation kinetics will be assessed using X-ray nano-tomography at different time points. This technique allows 3D structural reconstruction of the materials, with a resolution of up to 0.4 μm, providing key parameters such as porosity and solid phase size distribution. This will enable detailed tracking of structural decomposition over time.

The PhD candidate will work closely with a postdoctoral researcher in charge of modeling, ensuring strong integration between experimental and computational approaches.

**Key words:**biomaterials, materials for health, regenerative medicine

**École Doctorale :** BCS

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