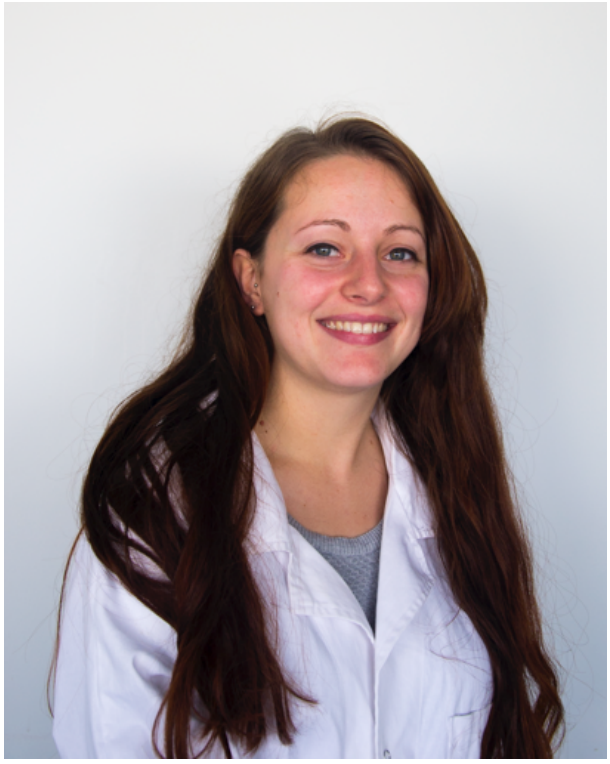

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Thesis director: Sylvain CATROS

Research Interests:

The context of this thesis is the regeneration of bone defects which can appear as a consequence of trauma, infection or cancer. It is hard to cure these loss of bone substitutes by conventional methods (autograft, implantation of biomaterials), especially in the case of large volume bone defects. So, it seems necessary to use tissue engineering techniques in some difficult clinical situations. It introduces specific methods which can provide all the necessary elements for the bone tissue regeneration, providing an osteoconducting support (scaffold), an osteogenic contingent (mesenchymal stem cells) and osteoconducting elements (growth factors). The conventional tissue engineering is called “top-down” approach and it is based on seeding of a scaffold on its surface. The main limitation of this approach is poor cell viability inside the scaffold due to the difficulty to mimic bone microarchitecture and microenvironmental conditions, and it leads to an insufficient diffusion of oxygen and nutrients and insufficient elimination of waste products. Another approach, the “bottom-up” approach is based on assemblies of small seeded blocks. Layer-by-Layer bioassembly is based on this approach.
This project aims to address some limitations of scaffold-based bone tissue engineering, by organizing sequentially cells inside the scaffold, using a Layer-By-Layer (LBL) fabrication method, in order to favour cell material interaction and to facilitate the maturation of these constructs, and finally to enhance the amount and quality of tissue regenerated. The first part of the project will consist in the fabrication of scaffolds membranes, made by Fused Deposition Modeling (FDM) using polymers. These sheets will be characterized for mechanical and physico-chemical properties. Then the bioassembly of the scaffolds will be done by different original methods developed in this project. The second part of the experiment will be focused on the *in vitro* evaluation of the benefits given by the LBL bio-assembly versus random seeding of massive macroporous scaffolds. In this part, we will use the stromal vascular fraction of adipose tissue, to be closer from a potential clinical translation. The survival, proliferation and differentiation of the cells will be evaluated, as well as their phenotype and histological aspects in the constructs. More specifically, the impact of different 3D organization of the cells during layer-by-layer fabrication will be explored. Finally, in the third part of the project, we will perform animal experiments to validate the *in vitro* results: the osteogenic properties of the materials will be first tested in ectopic (subcutaneous) sites of small animals. Then the bone regeneration will be observed after intra-osseous implantation of the constructs in dedicated intra-oral large animal models that mimic the clinical situation of an intra-oral bone defect. In all animal experiments, autologous stromal vascular fraction from the adipose tissue will be used.

Keywords/expertise:

- 3D printing
- Fused Deposition Modeling
- Bone tissue engineering
- Bioengineering
- Regenerative Medicine
- Cell Culture

Education:

Academic Background

2012-2017	Cursus Master Ingénierie Biomaterials for Health	University of Cergy-Pontoise – CERGY

Laboratory Internships & Professional Experiences

January – June 2017	Internship « Development of PLGA-HA-based biomaterial and physico-chemical characterization »	BioTis INSERM U1026 - BORDEAUX
October – December 2016	Project in collaboration with BioBank « Characterization of thermal impact on physicochemical properties of a material for osseous regeneration »	ERRMECe - CERGY-PONTOISE
January – February 2016	Internship « Study of medical devices in a clinic environment: Odontology & Oral health »	Bordeaux Hospital University Center (CHU) - BORDEAUX
June – July 2015	Internship "Biofunctionalization of osseous allograft with thin film charged in BMP2"	ERRMECe – CERGY-PONTOISE
January – Avril 2015	Project "Biofunctionalization of osseous allograft"	ERRMECe - CERGY-PONTOISE
June – July 2014	Internship "New therapy for breast cancer"	INSERM U976 - PARIS

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