Master 2 research internship in Integrated Structural & Cell Biology in Grenoble

Supervisor(s):
Elisa Migliorini, elisa.migliorini@cea.fr
Julien Gautrot, Queen Mary Universtiy of London, j.gautrot@qmul.ac.uk

Host laboratory:
BioSanté biosante-lab.fr/

Host group/team:
BRM

Title of the M2 research internship:
Biomimetic polymeric brushes presenting BMPs to induce stem cells osteogenic differentiation

Project summary:
The aim of this project is to study the role of proteins in bone growth and apply this knowledge to regenerative medicine. The aim is to propose implants that promote bone regeneration in vivo without the undesirable effects of current methods. This 3D biomaterial is made of polymer brushes carrying bone morphogenetic proteins (BMPs). In particular, BMP2 is a growth factor known for its osteogenic potential and for its clinical use for de novo bone formation. In vivo BMPs are presented to cells bound to the glycosaminoglycan heparan sulfate (HS). BRM team have shown that HS enhances BMP2-mediated osteogenic differentiation (Sefkow-Werner et al 2020, Migliorini et al 2017, Sales et al 2021). Employing HS-presenting biomaterials for future in vivo applications is not a sustainable strategy since HS encounters short life time if placed in an injured site due to its degradation by the enzymes heparinases. Polymer brushes are an attractive approach for tissue engineering, thanks to their simple fabrication, extracellular matrix-like structure and in vivo stability. In collaboration with the group of J. Gautrot at Mary Queen University of London (QMUL) we proved that these brushes bind to BMPs. The role of the candidate will be to test different brushes architectures, densities and thicknesses on BMP-mediated cellular response to identify the best conditions to obtain cell adhesion and differentiation. This project is part of a collaboration with J. Gautrot and with D. Boturyn at DCM, UGA. At QUML the student will learn how to grow polymeric brushes on 3D materials and at BRM team, the student will differentiate stem cells on top of these brushes.
We expect to recruit a highly motivated student with an interdisciplinary background on biology and/or biophysics and engineering. Good level of spoken and written English is important for the collaboration with the group in UK.

Keywords:
biomaterials, bone differentiation, polymeric brushes

Relevant publications of the team:
- Le Pennec, J., Picart, C., Vivès, R. R., & Migliorini, E. (2023). Sweet but challenging: tackling the complexity of GAGs with engineered tailor-made biomaterials. Advanced Materials.

- Marchena, M. H., Lambert, E., Bogdanovic, B., Quadir, F., Neri-Cruz, C. E., Migliorini, E., & Gautrot, J. E. (2024). BMP-Binding Sulfonate Polymer Brushes for Tissue Engineering. ACS Applied Materials and Interfaces under submission.

- Sefkow-Werner, J., Le Pennec, J., Machillot, P., Ndayishimiye, B., Castro-Ramirez, E., Lopes, J., . . . Migliorini, E. (2022). Automated Fabrication of Streptavidin-Based Self-assembled Materials for High-Content Analysis of Cellular Response to Growth Factors. ACS Applied Materials & Interfaces.

- Sefkow-Werner, J., Machillot, P., Sales, A., Castro-Ramirez, E., Degardin, M., Boturyn, D., . . . Migliorini, E. (2020). Heparan sulfate co-immobilized with cRGD ligands and BMP2 on biomimetic platforms promotes BMP2-mediated osteogenic differentiation. Acta Biomater.

- Migliorini, E., Guevara-Garcia, A., Albiges-Rizo, C., & Picart, C. (2020). Learning from BMPs and their biophysical extracellular matrix microenvironment for biomaterial design. Bone, 141, 115540.

- Sales, A., Khodr, V., Machillot, P., Chaar, L., Fourel, L., Guevara-Garcia, A., . . . Picart, C. (2022). Differential bioactivity of four BMP-family members as function of biomaterial stiffness. Biomaterials, 121363.