PhD proposal

Synthesis of bioactive hydrogels for the control of stem cell differentiation: impact on bone tissue engineering

The study of Mesenchymal Stem Cells (MSC, *stem cells able to generate osteoblast and then bone*) has raised the hope of a cell-based therapy for tissue engineering due to their high availability based on self-renewal and their high capability of differentiation into different kind of cells. These biological events, including stem cell self-renewal, migration, and differentiation, are orchestrated by a highly structured and complex cell microenvironment, so-called stem cell niche. Specifically, the extracellular matrix (ECM), a key component of the stem cell niche, provides various stimuli that drastically influence MSCs fate decision. Identification of factors that maintain their stemness properties, monitor and control MSC differentiation is crucial. *In vivo*, cells evolve following nanoscale physical and chemical signals they receive from ExtraCellular Matrix (ECM) surrounding cells. **The challenge lies in synthesizing materials able to reproduce these processes. Such materials could be used for implantation, but also as physiologically relevant models in basic and translational studies of bone development, disease and drug discovery.**
The objective of our project is to create new bioactive bio-based scaffolds able to favour MSC differentiation into osteoblastic lineage.

The main objective of this research program will consist in:
-the synthesis of polymers with tunable stiffnesses to investigate the correlation between substrate rigidity and stem cell behavior.
-The mechanical characterization at nanoscale of these polymers correlated with their chemical and topographical properties determined by Atomic Force Microscopy and related spectroscopies
-the homogeneous bioactive functionalization of that polymers
Creating finely tuned in vitro microenvironments can be achieved thanks to the recent progress in microengineering techniques. In stem cell research, microfabrication techniques have been extensively used during the last decades as tool to–decipher and then recapitulate the complexity of stem cell niches. The study presented here describes a method to micropattern geometrically defined regions of at least 2 mimetic peptides, adjacently immobilized onto polymers.
-The chemical and physicochemical characterization of these polymers
-the *in vitro* evaluation of effect of functionalized polymers (functionalized with various peptides alone or in combination with various mechanical properties) on MSC differentiation into bone lineage.

This PhD program will be done in cotutelle between Bordeaux University in France and *Université Laval* in Quebec, Canada and in partnership with Dr Corinne Hoesli from McGill University (Canada).

Skills of the PhD :
-Materials and their characterizations
-Knowledge of cell culture
-Interest in pluridisciplinar subjects (from materials to cell biology)

Place of employment:

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Application:
Thanks to send your application (CV, letter of motivation, your university marks (results of Master 1 & 2) by e-mail to the 2 supervisors

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The salary is 1400 € per month before deduction of income tax.

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