Post doc subject : **Challenge "Interfaces"**

Multi-layered Scaffolds development for Tissue Engineering: An Approach to handle multi-organs reconstruction

Post doc Advisor:

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Context of the study:

This project is part of the activities of the Laboratory of Excellence (LABEX) at the Université de Technologie de Compiègne (UTC) in France on the Control of Technological Systems of Systems (MS2T) (www.labexms2t.fr). It is more specifically part of the Research topic 3: Optimized design of technological SoSs. The Labex funded in 2015 the Challenge "Interfaces led by Dr. C. Legallais : Tissues and cell Interfaces in muscle-skeleton system : Application to the design of bioartificial SoS" **The system of systems (SoS) of interest is a tissue engineered muscle-tendon-bone continuum.**

Post doc description:

Until recently the emphasis in the realm of tissue engineering has been on the development of reconstructed tissue with acceptable biological and mechanical properties. Different strategies were adapted based on differentiating stem cells in adapted cultural media such as electro-spun scaffold. All those attempts had as objective the development of substitute of a unique organ and did not consider the interaction that organ will have with the surrounding native tissues. Not taking such interaction could lead to the rejection of the implanted tissue which could put the developed strategy in real jeopardy. It is to remedy to this situation, that this proposal is submitted. Our objective is to build a methodology toward not only the development of a tissue substitute with the desired biological and mechanical properties but also able to "a priori" handle the interaction with the present native organs.

Our achievements, as well as discussions with our partners "end-users" involved in maxillofacial or orthopedic surgery led us now to confirm our concerns / challenges to target global system development in which different multi-layered tissues will be designed together. This concept supposes to study the interfaces between the biohybrid implant and the surrounding tissues, for an application in maxillofacial surgery, in dental implants, or any other cases of repair for the muscle-tendon-bone continuum. It represents an example of complex **bioinspired system of systems** in which the different systems are in continuous changes and interactions : indeed, basic cell-material interactions and mechanical stimuli drive the cell to the production of their own matrix (at the nanoscale level) that in turn modify the mechanical properties of the whole construct.

The structural complexity of the proposed reconstructed multi-layered bioengineered systems that makes them versatile also presents a major challenge to understand and predict their mechanical and biological behavior. In other word, to prevent the possible rejection and enhance the adhesion between the reconstructed tissue and its surrounding environment, the challenge will be the **controlled design** of the multi-layered sandwich that meet the **mechanical** and **the biological** desired **properties**. Mechanical properties are highly desired to guarantee the structural integrity of the system throughout the process (electrospinning, cell culture and clinical trial). The biological properties are the key properties to promote cell differentiation in vivo and/or in vitro.

Our previous expertise on tissue engineering using electro-spun scaffolds led to wide screening of possible interaction between cells proliferation/differentiation and used materials for different tissues

(tendon and bones). A good match between polymers, scaffold structure (fiber distribution and size) and cells was identified for each type of desired tissue (bone and tendon). These results are currently generated in the PhD thesis of Alejandro Garcia Garcia and Megane Beldjilali (both funded by Labex MSST).

The next step will be the development of a bi-layered structure, where each layer will be made of specific materials with the desired structure. As such, each layer should present the optimal interactions with the specific cells. The optimization of the culture conditions should help tune the cells response toward two distinct tissues properties. The advantage of such approach is to provide the optima condition for the two cells type to interact throughout the culture time, which in turn will help build strong interface prior to the in vivo tests. A major challenge for the post-doc will thus be the design and control of specific scaffolds that are able to meet these requirements.

The PI has strong collaborations with the New Jersey Center For biomaterials for polymer materials developments (Rutgers University), Materials Process and Simulation Center (CalTech) in materials simulation and Argonne Photon Source facility (University of Chicago) in materials characterization. Therefore the hired post-doc and the PI will maintain these collaborations through visits and invitations throughout the project.

Candidate's profile:

- Candidate should preferably have experience in polymer science mechanics and characterization. Interest for tissue engineering would be a plus.
- Interest and ability to work in an interdisciplinary research environment and across disciplines; teaming with material scientists, biomedical engineers and surgeons.
- Good English communication skills, including development/delivery of presentations to technical and non-technical audiences are required.
- Ability to write coherent and compelling scientific documents

Documents required to apply:

Send to fahmi.bedoui@utc.fr

- Curriculum vitae
- Motivation letter
- At least two references and/or recommendation letters
- A statement of research experience and interests

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