

Internship Proposal

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Project Title:

Functionalization and processing of biomaterials for application in tissue regeneration

Level:

Master Student

Project Summary:

The widespread use of polymers as biomaterials has significantly expanded owing to advances in the synthesis of polymers with controlled and functional architectures, which has improved the range of materials possible, as well as their biocompatibility. Natural polymers have been used to make natural hydrogels as scaffolds for tissue engineering owing to their biocompatibility, inherent biodegradability and critical biological functions 1. Hydrogel-based biomaterials have been applied either as scaffolds for tissue regeneration 2 or as 3D in-vitro models for cell culture 3 , 4. Several functionalization strategies may be applied to provide stability and improve physico-chemical, mechanical and biological behaviour 5. The goal is to develop biomaterials that can be applied either as injectable hydrogels, porous scaffolds, mouldable pastes or membranes, addressing clinically relevant pathologies such as chronic wounds, bone fractures and spine disorders, periodontitis, osteoarthritis. Additional processing through bioprinting may create porous structures with tailored format that can better adapt to tissue defect size and shape 6, 7.

The translation of such biomaterials to clinics is a major goal, providing disruptive therapeutic products to society and triggering a strong economic and social impact.

Work to be developed by the student:

The student will work on several steps related to the development and validation processes of a biomaterial, including:

- Polymer functionalization and characterization
- Biomaterial manufacture and processing
- Biomaterial characterization and testing
- Biological validation

The characterization of the materials will be performed through structural (FTIR, ¹H-NMR,



GPC, OCA), morphological (SEM-EDS, micro-CT) and mechanical (rheometer, texture analyser, DMA) characterization techniques. The biological validation of the biomaterial will comprise in-vitro assays with target cell lines and characterization applying conventional molecular biology techniques, immunohistochemistry, immunofluorescence, as well as bioimaging tools such as confocal microscopy, high content screening and imaging, fluorescence inverted microscopy.

Main requirements: basic knowledge of lab work, basic knowledge in chemistry, and at least 3 months availability. Cell culture basics would be advantageous, but not mandatory.

References:

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- 4.M. Redondo, R. Presa, P. L. Granja, M. Araújo and A. Sousa, *Materials Today Chemistry*, 2023, 34, 101761.
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- 6.R. F. Pereira, B. N. Lourenço, P. J. Bártolo and P. L. Granja, *Advanced Healthcare Materials*, 2021, 10, 2001176.
- 7.S. C. Neves, A. Sousa, D. S. Nascimento, I. D. Orge, S. A. Ferreira, C. Mota, L. Moroni, C. C. Barrias and P. L. Granja, *Materials Today Bio*, 2024, 29, 101291.