ITI HiFunMat Master Internship Proposal

☐ M 1 ☒ M 2

Elaboration and characterization of electrospun membranes with controlled pore sizes for biomedical applications

Internship supervisor

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Laboratory	ICPEES – UMR 7515
Collaboration with a HiFunMat member (*please indicate their name*)	☒ No ☐ Yes :

Student profile looked for

Master program (*more than one box can be ticked)*	☒ Material science and engineering ☐ Chemistry ☐ Physics
Other indications if necessary	

Internship description

Context and mission

The work will be carried out at the Institute of Chemistry and Processes for Energy, Environment and Health (ICPEES UMR7515) in the POLYFUN team (https://icpees.unistra.fr/en/polymer-engineering/electrospinning/.)

Electrospinning[1] is well-known to produce polymer nanofibrous membrane dedicated to liquid filtration applications. Nevertheless, the membranes obtained from this technique lead to pore size of several microns. Our team developed recently an original strategy[2] to reduce the pore size down to few tens of nanometers. Such membranes are ideal candidates for the treatment of type I diabetes thanks to the fabrication of an artificial pancreas allowing the controlled release of insulin produced by encapsulated cells[3]. The aim of this master thesis is to develop a new kind of membranes with intermediate pore size in the range of 50-500 nm in order to target other biomedical applications.

The project will be divided in three main parts:

1) Electrospinning and post-processing strategies will be developed to produce membranes with various porous morphology. Especially, different post-processing strategies will be deeply investigated to modulate the average size of the pores.
2) The structural properties of the obtained membranes (fiber diameter, pore size, porosity) will be assessed by several techniques (scanning electron microscopy, gas-liquid porometry, 3D imaging)
3) Diffusion through the membranes of labelled molecules of various controlled molar mass will be characterized by fluorometry.

Required skills

- Background in materials science
- Rigorous experimental work
- Curious and proactive.
- Ability to work in a team and communicate results

Skills to develop during the M2 internship

- Electrospinning
- Structural characterization of electrospun membranes: SEM, porometry…
- Fluorescence spectroscopy
- Mass transfer

Références

[1] D. Mailley, A. Hébraud, G. Schlatter, A Review on the Impact of Humidity during Electrospinning: From the Nanofiber Structure Engineering to the Applications, Macromolecular Materials and Engineering 306 (2021) 2100115. https://doi.org/10.1002/mame.202100115.

[2] B. Gross, G. Schlatter, P. Hébraud, F. Mouillard, L. Chehma, A. Hébraud, E. Lobry, Green Electrospinning of Highly Concentrated Polyurethane Suspensions in Water: From the Rheology to the Fiber Morphology, Macromolecular Materials and Engineering 2400157. https://doi.org/10.1002/mame.202400157.

[3] J. Magisson, A. Sassi, A. Kobalyan, C.-T. Burcez, R. Bouaoun, M. Vix, N. Jeandidier, S. Sigrist, A fully implantable device for diffuse insulin delivery at extraperitoneal site for physiological treatment of type 1 diabetes, Journal of Controlled Release 320 (2020) 431–441. https://doi.org/10.1016/j.jconrel.2020.01.055.