

Research engineer position 24 months
Starting date 1st February 2026

Title	Design of Microbial Membrane Structured Microreactors and Immobilized Cells for Intensified Sustainable Bio-production
Supervisors	Dr ALFENORE Sandrine (HDR) Dr FORMOSA DAGUE Cécile (HDR)
Laboratory	TBI (Toulouse Biotechnology Institute)
Keywords	Hydrogels, microorganism immobilization, bioproduction, local characterizations (AFM, microscopies)

Context and description of the project:

To meet the challenge of intensifying bioprocesses as part of sustainable bio-sourced routes, the ANR project **MIMEBIOTIC** proposes to design a bioreactor for densifying microorganisms of interest in a hydrogel supported on a membrane (membrane-supported hydrogel or MSH). The challenge is to maximize bioproduction performance (productivity, yields and/or titers, selectivity) by reducing mechanical constraints and physiological stresses that could alter microbial activity and performances in high-density cultivations. It combines microbial and process engineering approaches to understand and quantify (i) the impact of MSH bioreactor properties on biological activity, (ii) transfer and transport resistance phenomena and reactivity in hyperdense biological media, (iii) MSH bioreactor performance for targeted bioproduction. Immobilized cells in hydrogel is a relevant solution that combines high concentrations of catalytic biomass to reach high performances and step savings through the *in-situ* extraction/purification of the targeted microbial products provided by the selectivity of the membrane. Additionally, this configuration minimizes the amount of water in the process, combining reaction and separation, generating economic and environmental gains and making it more competitive than current processes. **However, the overall reactivity of a microbial system depends on the intrinsic metabolic kinetics and the limiting transfer resistance phenomena of substrates and metabolic products.**

The global ANR project is divided into four interconnected tasks. **The recruited person will be involved in tasks relative to the quantification of microbial kinetics to drive hydrogel immobilized cultures, the modelling of mass transfers and the optimization of operating conditions in pilot-scale membrane supported hydrogel reactor.** Details and organization are mentioned below:

M0-M6: Probing the mechanical properties of the hydrogels in presence of the microorganisms using microDMA (Dynamic Mechanical Analysis) AFM experiments. (6 months / C. Formosa-Dague)

M6-M18: Quantification of growth and production rates in suspended and immobilized cell cultivations and first microbial kinetic model (12 months / S. Alfenore).

M12-M24: Experimental validation of transport – reaction model in MSH reactor (12 months / S. Alfenore)

Required profile

Engineer or M2 in (bio)Chemical Engineering with knowledge or experience related to physical and chemical properties (materials, thermodynamics, etc.)

You are curious, autonomous, motivated to develop methodological developments, open to new methods. You are interested in developing your skills in project management and interdisciplinary interactions.

Experiences or skills in microbial cultures & membrane engineering would be an asset for this project. An experience in AFM is not required, though it would be an asset.

How to candidate?

Send a pdf file including CV, cover letter, and 2 letters of recommendation by Email before Nov, 30th
@ Sandrine Alfenore alfenore@insa-toulouse.fr and Cecile Formosa-Dague formosa@insa-toulouse.fr