Controlling biofilm development in a new generation of photobioreactors for microalgae production

Microalgae have been identified as a promising biomass feedstock for the production of biofuels, feeds, foods and high-value with applications in markets such as cosmetics, pharmaceutical, nutritional, and aquaculture. They are mostly cultivated as suspended cells in open and closed systems, raceways and photobioreactors (PBR), respectively. Though higher productivity is achieved in PBR compared to raceways, technological breakthroughs are still needed to reduce production costs and environmental impacts. Among them, the development of PBR technologies less prone to biofouling (biofilm development on the reactor's surfaces) is one of the priorities. A biofilm is an assemblage of microbial cells that are irreversibly associated with a surface and enclosed in a matrix of extracellular polymeric substances. In case of PBR, biofouling contributes to light attenuation, thus impacting photosynthetic cells growth and ultimately productivity.

The aim of this Master's internship is to develop a biofilm control management procedure to limit biofouling in a new generation of flat-panel reactors. The hired Master's student will work in the context of a national project (ANR), which is focusing on the development and optimization of novel flat-panel PBR for microalgae cultivation.

Bioprocess operational parameters (gas flow rate, bubble size, …) will be tested to identify conditions that minimize biofouling. Confocal Laser Scanning Microscopy (CLSM) and Optical Coherence Tomography (OCT) will be used to monitor biofilm development and its resistance to detachment. Additionally, hydrodynamics conditions, such as shear stress, will be characterized.

This project will be carried out in the Laboratory of Chemical Engineering and Materials (*LGPM, Bioprocess team*), CentraleSupélec/University Paris-Saclay, Gif-sur-Yvette, in close collaboration to the other partners of the ANR project.

Required skills: Microbial culture

Fellowship duration: 6 months starting in the beginning of 2024.

Contact: Please contact Filipa Lopes (filipa.lopes@centralesupelec.fr), and Andrea Fanesi (andrea.fanesi@centralesupelec.fr) for further information.

How to apply? Please send a CV and a cover letter to Filipa Lopes and Andrea Fanesi using the above mentioned contact information.

References:

Fanesi, A., Lavayssière, M., Breton, C., Bernard, O., Briandet, R., & Lopes, F. (2021). Shear stress affects the architecture and cohesion of *Chlorella vulgaris* biofilms. *Scientific reports*, *11*(1), 1-11.

Fanesi, A., Paule, A., Bernard, O., Briandet, R., & Lopes, F. (2019). The Architecture of Monospecific Microalgae Biofilms. *Microorganisms*, *7*(9), 352.

Grenier, J., Bonnefond, H., Lopes, F., & Bernard, O. (2019). The impact of light supply to moving photosynthetic biofilms. *Algal Research*, *44*, 101674.

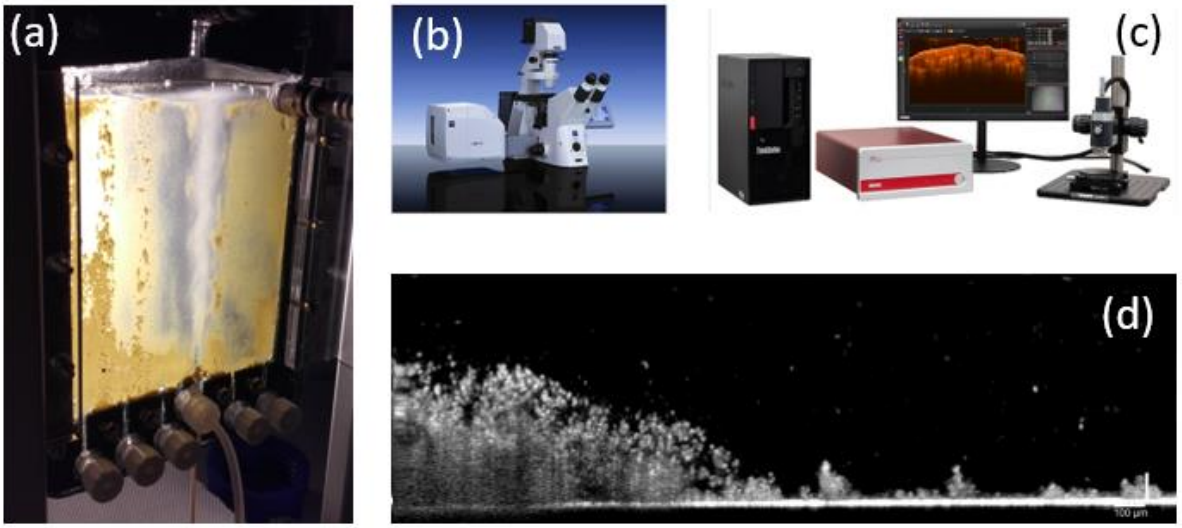

Figure 1. Example of photobioreactor that will be used during the experiments (a) and pipeline of imaging techniques, CLSM (b) and OCT (c) typically used in biofilm studies. In (d) and example of biofilm growing in the photobioreactor is reported.