CALL FOR APPLICATIONS
PhD student Position
Biophysics – Chemical Engineering
Doctoral School MEGEP – University of Toulouse
LISBP, INSA de Toulouse

“BIOPHYSICS OF MICROALGAE FLOTATION”

General context

Microalgae are photosynthetic microorganisms that are currently receiving an increasing attention as they represent an important source of biomass and molecules of interest such as carbohydrates, proteins or pigments, and an alternative and renewable source of energy because of their high capacity of producing oil that can be used as biofuels. However, large-scale production of microalgae biomass faces a number of technical challenges that have made their industrial use economically unviable. The main limitation encountered is the harvesting of microalgae, which consists in removing them undamaged from their aqueous culture medium where their concentration is low, at a minimal cost. This crucial step has been assumed to account for one third of the entire price of microalgal biomass production in industrial processes. In this context, dissolved air flotation (DAF) is a promising harvesting technique that consists in air or gas transformed into bubbles rising through a microalgal suspension. As a result, microalgae cells get attached to the bubbles, and are carried out and accumulated on the surface. Thus flotation allows cell harvesting at low cost, as it is a rapid operation that needs low space. It could thus overcome the bottleneck of feasible microalgal production. However, flotation harvesting is challenging in the case of microalgae as they do not easily adhere to bubbles because of their negative surface charge and their low surface hydrophobicity. It is thus necessary to develop an original flocculant-free flotation technique, allowing to harvest efficiently microalgae cells at high scale to further valorize this biomass.

Objectives and proposed work

The first objective of this project is to make flotation an efficient harvesting technique in order to better exploit the potential of the microalgal bioressource. The strategy proposed to reach this objective is based on the functionalization of bubbles with adhesive compounds that will attach to the cells and bring them to the surface. These adhesive compounds will be directly extracted from the microalgal cell wall to avoid cell toxicity and impairment of the final products derived from the microalgal biomass. Then the mechanism of adhesion of the functionalized bubbles to the cells will be deciphered using a biophysical approach: the second objective of this research project is thus to develop a new method to probe bubble-microorganism interactions at the nanoscale. To do so, a combination of atomic force microscopy (AFM) and microfluidics (FluidFM) will be used in order to produce micro-sized bubbles at the end of AFM cantilevers, and prove their interaction with individual cells. Finally the efficiency of the functionalized bubbles will be experimentally evaluated and simulated at higher-scales using scale-up modelling approaches.
Candidate profile

We seek for high level candidates with a master degree in biophysics preferentially or chemical engineering, and a first experience in research (in an academic laboratory or in a research & development department of an industrial company), as requested by the Doctoral School Cf. [http://www.ed-megep.fr/](http://www.ed-megep.fr/). The candidate must be highly motivated and wanting to do multidisciplinary works, experimental sciences and biophysics. Through his formation or experiences, the candidate can also have demonstrated skills in the following domains: chemical engineering, numerical simulations, programming, and biochemistry. English speaking and writing is compulsory.

Research group

LISBP – Toulouse, France ([http://www.lisbp.fr/fr/index.html](http://www.lisbp.fr/fr/index.html)), within the research department Sustainable Chemical Engineering, and the team TIM. The work will also be performed in a collaboration with LAAS-CNRS and the Research Federation Fermat.

Contract terms

**Thesis duration:** 36 months, starting in October 2019  
**Employer:** SAIC INSA de Toulouse  
**Doctoral School:** Mechanics, Energetics, Civil and Process Engineering (MEGEP, ED 468)  
**Salary:** Application Engineer level corresponding to a gross salary of ~2000€/month according to experience  
**Funding:** secured, grant from the Agence Nationale pour la Recherche (ANR)

Supervisors

Dr. Cécile Formosa-Dague ([formosa@insa-toulouse.fr](mailto:formosa@insa-toulouse.fr)) and Prof. Pascal Guiraud ([pguiraud@insa-toulouse.fr](mailto:pguiraud@insa-toulouse.fr))

Application steps

Candidates must send a single PDF file containing a Curriculum Vitae, Master 1 scores, Master 2 scores if available, and a motivation letter in English, by e-mail to Dr. Cécile Formosa-Dague and Prof. Pascal Guiraud. Depending upon the matching of the candidate to the profile, an interview can possibly be organized and supplementary information can be requested. Applications will continuously be examined until a candidate is chosen.