Surface forces of biological active fluid

Context and objectives

Capillary adhesion makes possible to erect sand castles or that allows insects (such as certain spiders) to move on the ceiling. The references [1,2,3,4,5,6,7,8] provide basic notions and illustrations of these phenomena on interfaces, capillarity, wetting. For more concrete industrial problems, capillary bridges are used to move very small objects, perform efficient heat exchanges or simply appear in a harmful way. The purpose of this internship is to study the evolution of a liquid bridge between two rigid plates with a biological active fluid (bacteria secreting bio-surfactants). The results of this experimental study will then be compared to theoretical results. The idea is to use a confined geometry (capillary bridge) as a model experiment to determine the interface properties (surface tension, evaporation) as a function of the activity of the bacteria (secretion of bio-surfactants, creation of a bio-film, etc). This system will have industrial application for the characterisation of bio-surfactants.

Intership content

1. Quick bibliographical review
2. Development of the measurement procedure in two cases :
    a. Mechanical procedure which consists in stretching the liquid bridge by gradually moving the two plates apart until reaching the breaking point.
    b. Evaporation procedure which consists of holding the two plates fixed and allowing the liquid to evaporate until breaking.
3. Automatic data treatment (required skills: Matlab)
4. Validation of experimental procedures and set-up precision: Tests on model fluids (water, ethanol,) and different surface states of the plates (aluminum, copper, polyethylene ...).
5. Testing of biological fluids in collaboration of the institute of biology of Aix-Marseille University (Prof. Bolla). Analysis of the motion of bacteria
6. Comparison with existing theory (with Loïc Tadrist) and numerical simulations (with Prof. I. Graur). Analysis of the effect of the production of bio-surfactants on interface properties (surface tension and evaporation). Creation of a new model of bio-surfactant production.

Environment: The research project labeled CABRIBIO (CApillary BRIdge for BIOlogical fluids) is supported by the Institute of Mechanics and Engineering of the University of Aix-Marseille (IUSTI laboratory). An semi-automatised experimental bench has already been developed.

Key words: Interfaces, Capillarity bridge, Measurement systems, Bio-surfactants.

Profile: Student in Master 2 or last year of engineering school. Skills in fluid mechanics and applied mathematics will be required.

Duration of the internship: 6 months (Master 2)

Supervisors: Maxime CHINAUD (maxime.chinaud@univ-amu.fr) and Lounès TADRIST (lounes.tadrist@univ-amu.fr)

Salary: 600 €/month + Participation to one conference.

Location: IUSTI Lab (8 Rue Enrico Fermi, technopôle de Château Gombert, 13013 Marseille).

Application procedure: email CV and short letter to maxime.chinaud@univ-amu.fr

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