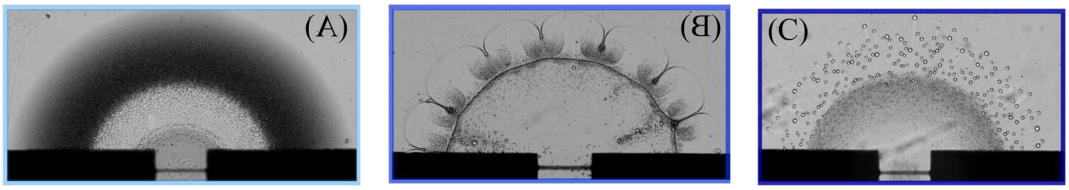
Phase separation of a binary solution

Proposal for a Master's internship 2 (4 to 6 months).

Context:

We recently showed that the use of an aqueous solution of thermo-sensitive ionic liquid enabled, above a critical temperature, the separation of the solution into two phases, one rich in water, the other rich in ionic liquid, thus generating a salt gradient between the two solutions [1]. L. Bocquet's group has shown that this salt gradient makes it possible to generate an osmotic electric current through a nanoporous membrane, with a power of 7W/m2 [2]. This opens up new prospects for the recovery of so-called waste heat, for which work in a closed-loop configuration is required.



Internship project

Until now, the separation of the binary solution has been carried out in radial geometry. Despite the complexity of the flow patterns, we have been able to model the three separation regimes (see figures). This geometry does not make it possible to recover both solutions under flow conditions (a drop of ionic liquid surrounded by water), yet it is this configuration that will make it possible to envisage energy recovery applications. The aim of the internship is therefore to study the phase separation of the binary solution in a conventional microfluidic channel under flow conditions. We expect a combination of thermocapillary (interfacial) and Poiseuille (volume) flows.
The student will be involved in fabricating the microsystems and carrying out experiments. The student may be involved in data processing and discussions on the modelling of these systems.

[1] Pascual *et al., Phys. Rev. Fluids* **6**, 114203 (2023).
[2] Pascual *et al., Energy Environ. Sci.,* **16**, 4539–4548 (2023).

Location:
Laboratoire IPR (Institut de Physique de Rennes) : https://ipr.univ-rennes.fr/

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We are looking for a student in Masters 2 or final year of engineering school with a background in physics, or mechanics with an interest in fluid mechanics and energy applications.