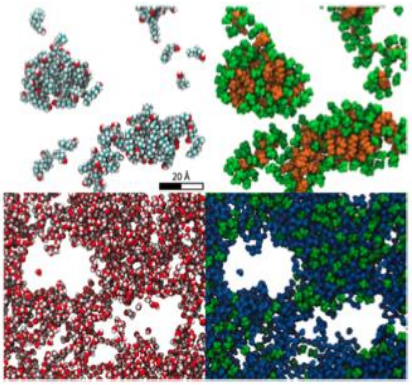
THERMAL STABILITY AND CRITICALITY OF SURFACTANT FREE MICROEMULSIONS UNDER VARIOUS CONSTRAINTS IN VIEW OF THEIR APPLICATIONS IN GREEN CHEMISTRY.

PhD Thesis funded for 36 months, beginning December 2021, Grenoble.



UltraFlexible MicroEmulsions are a class of ternary or quaternary complex fluids that are also referred to as "surfactant-free microemulsion". The mixing of water, a partially miscible polar "oil" (such as octanol), and a co-solvent with "hydrotropic" property (as typically, ethanol) is representative of mixtures found in numerous important applications, as for example advanced metal extraction or depollution. While the structure of the solutions in standard thermodynamics conditions has been studied in detail before, the goal of the PhD is to model the dynamics of the system as well as the influence of external fields like **gravitation field**.

Such investigation will enable to address fundamental characterization of the (nano)droplets formation and stability in view of establishing missing theoretical model in colloidal sciences, as proposed by the ienaics approach in separation chemistry. Moreover, unravelling the effect of molecular interactions by chemical substitution on the micro-structuration of the solution (hydrogen bonding, molecular branching, hydrophobicity) of thermal behavior will open new possible formulations in view of applications for green chemistry. This in-depth experimental study carried out by the PhD candidate, of the so-called “Ouzo” and “pre-Ouzo” effect will be approached by complementary experimental techniques enabling to probe both the structure and the dynamics of these complex fluids as the result of molecular interactions.

- First, the systems will be explored by X-rays scattering, combined dynamic and static light scattering as well as relaxation and diffusion measured by nuclear magnetic resonance: these will be performed along dilution lines in the phase prism. Then, **Neutron Scattering (NS) experiments** will be conceived and performed at the ILL as NS is the only method enabling a simultaneous investigation of the structural and dynamical properties of the different molecular species at the micro-meso scopic scale, by small angle scattering (SANS) and spectroscopic techniques (Time Of Flight and Neutron Spin Echo).
- Secondly, if successful in characterizing “simple” ternary systems, the perturbation of dynamics introduced by the presence of very insoluble solutes that are known to introduce a second critical point in a phase diagram will be quantified.
- Finally, near the classical critical point in the water-rich corner, as well as near to the new puzzling critical point centrifuge induced criticality will be studied i**n situ by optical and neutron scattering in a centrifuge up to 1000g** thanks to a novel method recently developed.

The PhD candidate will be based in Grenoble, at the Laboratory LIPhy (UGA campus) and at the Institut Laue langevin ILL (EPN campus). The work being performed in straight collaboration with the Laboratoire Léon Brillouin (Saclay) and the Institut de Chimie Séparative de Marcoule (Laboratoire LTSM), the candidate might have to travel in various places.

Requested background: master in chemical-physics or related fields (from physics, soft matter to chemistry including material science and/or chemical engineering). The PhD candidate must be an experimentalist, with the rigor required to carry out and analyze the experiments; Basic programming skills for data modeling are desirable. Good English level is requested.

Deadline for application: 15th October 2021

Contacts:

Marie Plazanet (LIPhy-UGA, marie.plazanet@univ-grenoble-alpes.fr), supervisor.
Ingo Hoffmann (ILL, hoffmann@ill.fr), supervisor.
Christiane Alba-Simionesco (LLB, christiane.alba-simionesco@cea.fr), advisor.
Thomas Zemb (ICSM, thomas.zemb@icsm.fr), advisor.