LadHyX/LMS Seminar – March 17, 14:00, – Room Jean Mandel (LMS)

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Visco-elasto-plasticity of dry liquid foams

At low deformation rate, a liquid foam is an elastoplastic material. Its structure is governed by the minimisation of the air/liquid interface area, and, in absence of applied stress, it corresponds to a local energy minimum. When a shear strain is applied, the energy increases until the bubble structure becomes unstable: a plastic event then occurs and relaxes the stored elastic energy. After a short introduction on these elasto plastic properties, I will focus on the viscous properties of the foam, i.e. the dissipation increase at high shear rate. A precise localization of the dissipation, and its mechanism at the bubble scale, is still lacking. To this aim, we simultaneously monitor, on a five films elementary foam, the local flow velocities, the film thicknesses and the surface tensions induced by different controlled deformations. These measurements allow us to build local constitutive relations for this elementary foam. We first show that, for our millimetric foam films, the main part of the film has a purely elastic, reversible behavior, thus ruling out the interface viscosity to explain the observed dissipation. We then highlight a generic frustration at the menisci, controlling the interface transfer between neighbor films and resulting in the localization of a bulk shear flow close to the menisci. A model accounting for surfactant transport in these small sheared regions is developed. It is in good agreement with the experiment, and demonstrate that most of the dissipation is localized in these domains. The length of these sheared regions, determined solely by the physico-chemical properties of the solution, sets a transition between a large bubble regime in which the films are mainly stretched and compressed, and a small bubble regime in which they are sheared. Finally, we discuss the parameter range where a model of foam viscosity could be built on the basis of these local results.