PhD PROPOSAL

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Soft foamy material from gelling foams

Foams, dispersions of gas bubbles in a fluid, are an example of complex out-of-equilibrium systems. The structure and properties of liquid foams are controlled by capillarity, so how foams flow or how they evolve in time depends mainly on the properties of their interfaces. In recent years there has been growing interest in "elastocapillary" foams, where bubbles are embedded in a soft solid. The properties of such foams are controlled by a competition between surface effects and bulk rheology (capillarity vs. elasticity), which can lead to a novel class of structural evolution and bubble topology, as shown in the photographs of quasi-2D foams below. Our objective is to rationalize the relation between the rheological properties of the continuous phase and resulting material properties, with a number of applications such as textured food foams or insulation for the building industry.

We will work with foams in which a colloidal gel is forming (silica nanoparticles, which aggregate and gel with the addition of salt). In time, the colloidal gel stiffens, it develops a yield stress and an elastic modulus. The characteristic gelling time and the gel stiffness can be controlled by changing the concentration of colloids or salt. We will follow the evolution of foam structure (bubble size and organization) and its rheological response. The combined measurements of microscopy and rheological properties should allow us to understand how the rheological properties of bubbles and continuous phase are coupled. This will advance us towards the creation of materials with novel mechanical properties.

We are looking for an enthusiastic experimentalist to work in a dynamic laboratory, and to enjoy collaborative working in an ANR-funded research program.

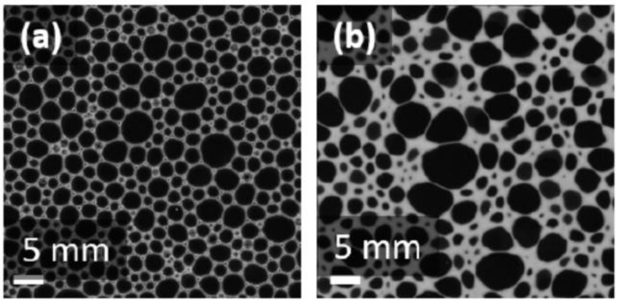

Figure 1. Foam structure of an ageing quasi-2D foam with a) an aqueous continuous phase, and b) a viscoelastic fluid from Guidolin et al. Nature Communications, 2023

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