**Mechanical, adhesive and rheological properties of liquid foams: A multiscale approach**

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Liquid foams are cellular soft materials comprising a random dispersion of gas bubbles in a small volume of a continuous liquid phase. They are related to many applications and depending on their formulation they can be categorised as cleaning foams, shaving foams, fire-fighting foams, biomedical foams (e.g. to stop bleeding), cosmetic foams etc. Their mechanical properties are of importance and are notoriously difficult to measure because of their squashy nature and soft consistency. We will use rheology, adhesion tensiometry and atomic force microscopy (AFM) to study the properties of liquid foams at the macroscale, mesoscale and microscale, respectively. We will combine experiments with modelling to elucidate their mechanical/rheological behaviour at several scales.

The experiments will take advantage of the unique suite of soft matter characterisation facilities available within the University of Edinburgh, using conventional rheology to study bulk foams (length scale ~ 1000s of bubbles), adhesion tensiometry / imaging to study local yielding (length scale ~ 10s of bubbles) and state-of-the-art AFM to probe dynamics on the single bubble scale. Furthermore, narrow gap/squeeze flow rheometry, using bespoke instrumentation developed at Edinburgh, can serve as a bridge between bulk and microscale experiments. Furthermore, numerical models (amenable to both shear rheology and necking measurements) will be used to capture the dynamics at the gas bubble level, so would provide microscopic insight complementary to experimental measurements.

The need for comprehensive, multi-scale understanding of foam rheology is motivated by applications, e.g. the initial spreading of shaving foam will reflect bulk properties while local, bubble-scale dynamics will determine its ultimate performance as a lubricant. Although the project primarily targets the fundamentals, given its relation to practical applications we will pursue such connections with our industrial links and contacts.

