Bubble stabilization by particles: a microfluidic study

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The stabilisation of foams and emulsions by solid particles is an avenue that has recently received great attention, owing to the significant decrease of aging that can be achieved. In such a foam, the particles adsorb at the air-liquid interface and create so called armoured bubbles, which can resist shrinkage and therefore counteract Ostwald ripening.

Recently, a microfluidic device was developed to study the stability of a single bubble against the dissolution, as a minimal model for an aging foam [1]. This device enabled us to produce a single air bubble and to coat it with particles as it flowed through a long channel, in addition to measuring the rigidity of the armour [1]. Here we use the same device to address the mechanisms for particle adsorption as the air bubble travels through the coating channel (Figure 1A). The final coverage is found to depend on the particle size and concentration, as well as on the bubble velocity. For instance, the interface coverage is higher for slowly moving bubbles compared with fast bubbles (Figure 1B). These effects can be understood by considering the flow of particles in the lubrication film that forms between the moving bubble and the rectangular channel walls.

Finally, questions on bubble coverage and interface stability are currently being addressed on armours formed by non-spherical particles that are relevant to the food industry.

Figure 1 (A) The coverage of the bubble in the channel in the evolution of time (0.5 wt.% 1.0 µm particles, \( U = 0.71 \) mm/s). The scale bar is 1 mm. (B) The coverage of the bubble vs. the fluid velocity for 1.0 µm particles (0.5 wt. %). The scale bar is 100 µm.