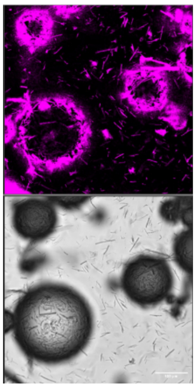
Understanding stabilization mechanisms of SU-8 microrods in Pickering foams

Andrea Marfuggi [a], Karl Van Holder [a], Ruth Cardinaels [a,b] and Erin Koos [a]

[a] *SMaRT (Soft Matter, Rheology and Technology), Department of Chemical Engineering, KU Leuven, Celestijnenlaan 200J, Leuven, 3001, Vlaams-Brabant, Belgium*
[b] *Department of Mechanical Engineering, TU Eindhoven, Groene Loper 5, Eindhoven, 5600, Noord-Brabant, Netherlands*

andrea.marfuggi@kuleuven.be

Particle-stabilized liquid foams have attracted significant attention in colloid and interface science due to their enhanced stability and reduced reliance on surfactants. While the effects of particle size [1], surface charge, and wettability [2] are well established, the role of particle shape in foam stabilization remains comparatively underexplored [3].
In this work, we investigate the stabilization mechanisms of liquid foams formed by anisotropic SU-8 microrods fabricated via a solvent attrition method. First, the fundamental mechanism of rod formation has been investigated, imaging the batch at different mixing times. Here, a tip streaming origin of the rods was confirmed thanks to the presence of droplets with highly elongated tips in the continuous phase at limited mixing times. Subsequently, foams were generated by simple hand shaking, without any surfactant or co-stabilizer, using microrods with varying weight fractions and polydispersity. An optimal intermediate microrod concentration was identified, yielding maximal long-term foam stability.
Foam conductivity measurements and X-ray tomography were used to quantify the incorporated air fraction and to distinguish between bubbly liquid and true foam regimes. The resulting “hairy” armoured bubbles, arising from the high aspect ratio of the absorbed particles, significantly hinder film drainage and coalescence between approaching bubbles.
Interfacial properties were further investigated using Langmuir trough experiments and interfacial shear rheology, both coupled with optical microscopy. These measurements revealed predominantly elastic interfacial behaviour, supporting an interfacial stabilization mechanism, relevant for interfacial deformation occurring during bubble deformation.
In Figure 1 an example interfacial adsorption of SU-8 rods is shown. Here, rods can be seen adhering at the interface, having some rods also protruding out from the bubble. Overall, this study demonstrates how particle anisotropy and wettability can be exploited as key design parameters for surfactant-free foam systems.



Confocal and optical micrographs of air bubbles in the liquid medium of water/glycerol 80:20 with SU-8 rods

References:

[1]Mackay, Isobel, et al. Minerals Engineering 124 (2018)
[2] Murmu, Kaniska, Manas Mukherjee, and Madivala G. Basavaraj. *Colloids and Surfaces A: Physicochemical and Engineering Aspects* (2025)
[3] Karakashev, Stoyan I., et al. *Colloids and Surfaces A: Physicochemical and Engineering Aspects* (2011)