Coarsening of foams with gas mixtures

Céline Hadji [1]

Ali Reda [1]

Élise Lorenceau [1]

Benjamin Dollet [1]

[1] Laboratoire Interdisciplinaire de Physique, CNRS and Université Grenoble Alpes, France

E-mail: benjamin.dollet@univ-grenoble-alpes.fr

ABSTRACT

Coarsening of liquid foams is a classical subject [1], but in most studies, bubbles are filled either with air or with a single gas species (e.g. nitrogen). In such a case, coarsening proceeds by Ostwald ripening, i.e. the exchange of gas driven by Laplace pressure differences. We show that as soon as gas mixtures are involved, partial pressure differences completely overtake Laplace pressure differences as driving force for coarsening, and lead to dramatically different coarsening dynamics. Experimentally, we study two-dimensional foams confined between plates, which gives access to the coarsening dynamics at the bubble scale, and in contact with air from the horizontal sides. We use different gas mixtures like air/nitrogen, air/carbon dioxide, or vapours of either very water-soluble (e.g. ethanol) or water-insoluble (e.g. perfluorohexane) species. We show that depending on the solubility ratio between the different gas species involved, foams either swell or shrink, and bubble area depends strongly on their distance from the foam/air boundary. We rationalise our measurements by modelling the permeation of gas across each films driven by partial pressure differences, which leads to a nonlinear diffusion equation which reproduces well our experiments.

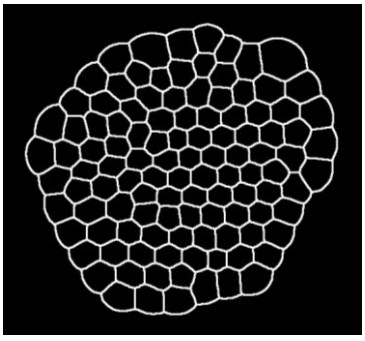

Figure 1: Snapshot of a coarsening 2D foam containing perfluorohexane; bubbles are noticeably bigger along the air/foam boundary.

[1] I. Cantat, S. Cohen-Addad, F. Elias, F. Graner, R. Höhler, O. Pitois, F. Rouyer and A. Saint-Jalmes. Les mousses - Structure et dynamique. Belin (Paris), 2010.