

Bubble shapes in foams: The importance of being isotropic

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A three-dimensional random foam exemplifies a large class of cellular materials undergoing processes known as coarsening or aging. This evolution proves intimately connected with the geometry of the cells (bubbles), particularly in generic cases where the cells are space-filling polyhedra. In a mean field-like approach, we define classes of isotropic bubbles (called *Isotropic Plateau Polyhedra*) [1], whose geometrical properties such as specific surface area or edge length are (i) close to the average found in random foam, and (ii) can be analyzed without resorting to approximations. These bubbles serve as “yardsticks” for cell geometry as well as “pacemakers” for foam coarsening.

Individual isotropic bubbles can also be found in experiment, and put to good use: While thin films can be measured interferometrically when they are prepared in isolation, such a measurement becomes very difficult for films on foam bubbles in their “natural environment”. We measure the shape and degree of isotropy of tetrahedral bubbles using a stereoscopic setup, and observe their rate of diffusive coarsening. With this information, the thickness of the films is determined with a few nm accuracy. Black film thicknesses of several 10 nm are measured, demonstrating a slow rate of film drainage [3].

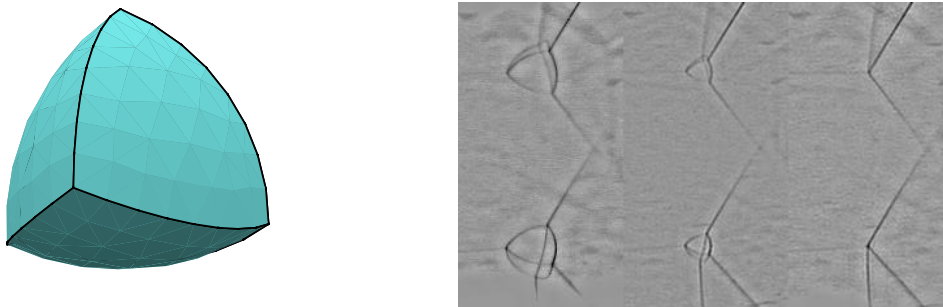


FIG. 1. Left: Theoretical shape of an isotropic tetrahedral foam bubble (Reuleaux tetrahedron). Right: Time series of a shrinking tetrahedral bubble in a foam in stereoscopic view.

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- [2] S. Hilgenfeldt, A. M. Kraynik, S. A. Koehler, and H. A. Stone, *Phys. Rev. Lett.* **86**, 2685 (2001).
- [3] A. van Doornum and S. Hilgenfeldt, *Foam tetrahedra: Isotropic bubbles as a tool for in situ film thickness measurements*, submitted to *Phys. Rev. Lett.*