Title: Cyclic deformation of bidisperse two-dimensional foams

Author(s): Vaz, M. Fatima[1]; Cox, S. J.[2]; **Teixeira, P. I. C.**[3,4]

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Abstract: In-plane deformation of foams was studied experimentally by subjecting bidisperse foams to cycles of traction and compression at a prescribed rate. Each foam contained bubbles of two sizes with given area ratio and one of three initial arrangements: sorted perpendicular to the axis of deformation (iso-strain), sorted parallel to the axis of deformation (iso-stress), or randomly mixed. Image analysis was used to measure the characteristics of the foams, including the number of edges separating small from large bubbles N-sl, the perimeter (surface energy), the distribution of the number of sides of the bubbles, and the topological disorder mu(2)(N).

Foams that were initially mixed were found to remain mixed after the deformation. The response of sorted foams, however, depended on the initial geometry, including the area fraction of small bubbles and the total number of bubbles. For a given experiment we found that (i) the perimeter of a sorted foam varied little; (ii) each foam tended towards a mixed state, measured through the saturation of N-sl; and (iii) the topological disorder mu(2)(N) increased up to an "equilibrium" value. The results of different experiments showed that (i) the change in disorder, Delta mu(2)(N), decreased with the area fraction of small bubbles under iso-strain, but was independent of it under iso-stress; and (ii) Delta mu(2)(N) increased with Delta N-sl under iso-strain, but was again independent of it under iso-stress. We offer explanations for these effects in terms of elementary topological processes induced by the deformations that occur at the bubble scale.

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Reprint Address: Vaz, MF (reprint author), Univ Tecn Lisboa, Inst Super Tecn, Inst Ciencia & Engn Mat Superficies, Ave Rovisco Pais, P-1049001 Lisbon, Portugal.

Addresses:
1. Univ Tecn Lisboa, Inst Super Tecn, Inst Ciencia & Engn Mat Superficies, P-1049001 Lisbon, Portugal
2. Aberystwyth Univ, Inst Math & Phys, Aberystwyth SY23 3BZ, Dyfed, Wales
3. Inst Super Engn Lisboa, P-1950062 Lisbon, Portugal
4. Univ Lisbon, Ctr Fis Teor & Computac, P-1649003 Lisbon, Portugal

E-mail Address: fatima.vaz@ist.utl.pt

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