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Crack propagation speed in quasi two-dimensional dry foam[1]
SHEHLA ARIF, Mechanical Engineering, Northwestern University, SASCHA HILGENFELDT, Mechanical Science and Engineering, University of Illinois at Urbana-Champaign — Quasi two-dimensional dry foam in a Hele-Shaw cell is used as a model system to study crack propagation, with the mm-sized bubbles playing the role of discrete atoms or molecules in a lattice. Pressurized air induces finger-like ductile failure (at low rate of applied stress) or brittle cleavage with breakage of successive films (at high rate of applied stress). We find that the upper limit speed of ductile cracks is lower than the lower limit speed of brittle failure (a velocity gap exists). To understand both processes requires balancing viscous and surface tension forces in the Plateau borders of the foam bubbles. Time scales can then be derived for the lateral gliding of bubbles past each other (necessary for ductile failure) and the stretching and rupture of films (necessary for brittle failure). We compare the derived brittle-crack speeds with the experimentally observed values of several m/s, resolved by high-speed photography.

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