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Crack Propagation Dynamics and Film Instability in Liquid Foams SASCHA HILGENFELDT, Mechanical Science and Engineering, University of Illinois at Urbana-Champaign, PETER STEWART, Oxford Centre for Collaborative Applied Mathematics, Mathematical Institute, The University of Oxford, STEPHEN DAVIS, Department of Engineering Sciences and Applied Mathematics, Northwestern University — Quasi-two-dimensional liquid foams (a single layer of foam bubbles between parallel plates) are model systems for the behavior of solid-state materials, including their flow and failure. Upon introduction of pressurized air, the foam layer was shown to yield and fail in two different ways, analogous to ductile and brittle fracture. The microscopic processes of deformation, plasticity, and loss of cohesion on the bubble scale are accessible in detail to experiment and modeling, using elements of fluid dynamics, stability theory, and surface chemistry. A simplified network model of liquid nodes captures both fracture modes and allows for quantitative assessment of microscopic effects. For the brittle crack propagation, which involves breakage of a succession of thin liquid films, we show that viscosity and Marangoni stresses can play significant roles in determining film instability and thus the time scales of foam failure, with important consequences for practical applications such as metal foam manufacture or oil recovery.

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