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Brittle-to-ductile transition for fracture in aqueous foam SHEHLA ARIF, Mechanical Engineering, Northwestern University, JIH-CHIANG TSAI, SASCHA HILGENFELDT, ESAM and Mechanical Engineering, Northwestern University — We use soap foam, a yield stress shear-thinning power-law material, as an experimental model system for failure (fracture) in crystalline condensed matter. A quasi-two-dimensional sample of foam is confined in a channel between parallel plates in a Hele-Shaw set-up, and is then stressed by injecting pressurized air. Depending on the magnitude as well as the rate of the applied air pressure, the foam yields by either brittle or ductile fracture. The former is characterized by breaking thin films and small strains, the latter involves defect formation and motion (T1 transitions) without film breakage. The millimetric bubble size and moderate crack speeds allow for a detailed dynamical study of these processes, down to the microstructure encoded in the foam geometry, rendering the interaction of material defects with the crack tip accessible. The observed rate dependence, as well as the existence of a velocity gap between the fracture modes, suggests that the model faithfully reproduces features seen in hard crystalline matter. In addition, however, foam allows us to observe the brittle-to-ductile transition dynamically within the same fracture event. Thus, the behavior on a microstructural level can be studied throughout the transition process, allowing quantification of the changing stress field around the crack tip in the material.

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