Fracture dynamics in foam: Finite-size effects

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ABSTRACT

Injection of a gas into a gas/liquid foam is known to give rise to instability phenomena on a variety of time and length scales. Macroscopically, one observes a propagating gas-filled structure that can display properties of liquid finger propagation as well as of fracture in solids. Using a discrete model, which incorporates the underlying film instability as well as viscous resistance from the moving liquid structures, we describe brittle cleavage phenomena in line with experimental observations. We find that the dimensions of the foam sample significantly affect the speed of the cracks as well as the pressure necessary to sustain them: cracks in wider samples travel faster at a given driving stress, but are able to avoid arrest and maintain propagation at a lower pressure (the velocity gap becomes smaller). The system thus becomes a study case for stress concentration and the transition between discrete and continuum systems in dynamical fracture; taking into account the finite dimensions of the system improves agreement with experiment.