Abstract Submitted
for the DFD10 Meeting of
The American Physical Society

Understanding the spontaneous brittle-to-ductile transition in foam fracture SHEHLA ARIF, Mechanical Engineering, Northwestern University, JIH-CHIANG TSAI, Institute of Physics, Academia Sinica, Taiwan, SASCHA HILGENFELDT, Mechanical Science and Engineering, University of Illinois at Urbana-Champaign — A single layer of aqueous foam bubbles in a Hele-Shaw cell, when exposed to compressed air, can fail in both a brittle and a ductile fracture mode. Unlike fracture in hard crystalline matter, where either mode can be induced through external parameter changes, we observe that cracks in foam can transition *spontaneously* from the brittle to the ductile stage. The transition occurs dynamically and is accompanied by the cessation of film rupture and an abrupt change in crack speed obeying a gap of forbidden velocities. The spontaneous transition can be understood through the continuous action of dissipation through air flow in the expanding fracture channel. An accompanying theory based only on fluid dynamics and bubble geometry explains quantitatively the mechanism and location of this transition, as well as the dependence of the phenomenon on experimental parameters. The new insights are applicable beyond foam physics to fields like hydraulic fracture.

Sascha Hilgenfeldt
Mechanical Science and Engineering, University of Illinois at Urbana-Champaign

Date submitted: 03 Aug 2010 Electronic form version 1.4