Abstract Submitted
for the DFD11 Meeting of
The American Physical Society

Solidification of molten metallic foams[1] PETER STEWART, MICHAEL DAVIS, STEPHEN DAVIS, Northwestern University — High-porosity metallic solids can be formed by solidification of the corresponding molten gas-liquid foam. However, molten metallic foams are thermally and dynamically unstable, so in the absence of solidification the thin liquid films drain rapidly toward the bubble vertices and eventually become unstable to interfacial instabilities, leading to film rupture and bubble coalescence. To explore the competition between coarsening and freezing we have constructed a large-scale network model to describe the dynamics and stability of a planar foam with low liquid fraction, incorporating a coupling between pressure and volume in the gas bubbles, surface tension forces on the gas- liquid interfaces, draining flow in the films, a criterion for film rupture, thermal fluctuations and a solidification front. Initially, the foam is arranged in a regular array of approximately polygonal bubbles, held at a uniform temperature above the melting point of the material. The walls of the container are then cooled to a temperature well below the melting point, driving a solidification front inwards; numerical simulations of the model predict the structure of the resulting porous metal solid.

[1]National Science Foundation Grant Nos. CMMI-0826703 (PSS,SHD) and DMS-0636574 (MJD)

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Date submitted: 05 Aug 2011 Electronic form version 1.4