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Effects of porosity on shock-induced melting of honeycomb-shaped Cu nanofoams. FENGPENG ZHAO, Institute of Systerms Engineering, CAEP — Metallic foams are of fundamental and applied interests in various areas, including structure engineering (e.g., lightweight structural members and energy absorbers), and shock physics (e.g., as laser ablators involving shock-induced melting and vaporization).Honeycomb-shaped metallic foams consist of regular array of hexagonal cells in two dimensions and have extensive applications and represent a unique, simple yet useful model structure for exploring mechanisms and making quantitative assessment. We investigate shock-induced melting in honeycomb-shaped Cu nanofoams with extensive molecular dynamics simulations. A total of ten porosities (phi) are explored, ranging from 0 to 0.9 at an increment of 0.1. Upon shock compression, void collapse induces local melting followed by supercooling for sufficiently high porosity at low shock strengths. While superheating of solid remnants occurs for sufficiently strong shocks at phi<0.1. Both supercooling of melts and superheating of solid remnants are transient, and the equilibrated shock states eventually fall on the equilibrium melting curve for partial melting. However, phase equilibrium has not been achieved on the time scale of simulations in supercooled Cu liquid (from completely melted nanofoams). The temperatures for incipient and complete melting are related to porosity via a power law and approach the melting temperature at zero pressure as phi tends to 1.

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