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Anomalous Grain Size Dependence of Dynamic Mechanical Properties in Nanocrystalline SiC Ceramics Under Shock Loading WANGHUI LI, South China University of Technology, ERIC HAHN, Los Alamos National Laboratory, XIAOHU YAO, South China University of Technology, TIMOTHY GERMANN, BIAO FENG, Los Alamos National Laboratory, XIAOQING ZHANG, South China University of Technology — Shock induced plasticity, structural phase transition, as well as dynamic damage and fracture in nanocrystalline SiC ceramics with grain size varying from ˜2 to ˜32 nm are investigated systematically by large scale molecular dynamics simulations with shock particle velocities varying from 1 to 5 km/s. Deformation twinning identified at Up = 2 km/s decreases with decreasing grain size with a breakdown in the range from 10 to 6 nm of the grain size. Statistics from grain size effects on the phase transformation from Zinc-Blend to Rock-Salt structure at different particle velocities are obtained. Spall strengths are evaluated by an indirect free-surface method, akin to experimental measurements, and a direct method evaluating the atomic stress tensor at the point of spallation. An anomalous grain size dependence of the tensile strengths is revealed. The ultimate tensile strength decreases with decreasing grain size for all different particle velocities. However, the nucleation tensile stress at Up = 1 km/s shows an inverse Hall-Petch (IHP) effect, and then a Hall-Petch (HP) relationship as the grain size is reduced, which shows similar to a theoretically predicted trend in nanoscale systems at high strain rate.

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