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Multiscale Modeling of Shocked Ceramics RUQIANG FENG, JIANBIN ZHU, University of Nebraska-Lincoln — Under shock compression, polycrystalline ceramics may undergo mesoscopically heterogeneous inelastic deformation via transgranular slip or twinning in some grains. Although polycrystal modeling, which accounts for crystal anisotropies and grain-to-grain topological variations and permits implementation of crystal plasticity models of interest, may be used to analyze such a deformation, the size affordable is too small to run wave propagation simulations needed to extract material properties from a plate impact experiment. To address this issue, we have developed a multiscale modeling technique, in which a Voronoi polycrystal is embedded in a homogeneous matrix of the size proper for simulating the experiment. The polycrystal model considers nonlinear crystal elasticity and microplasticity by limited slip systems. The matrix model uses the mean stress response predicted by elastic polycrystal simulation and a strength model combining the Drucker-Prager plasticity with a prescribed limiting strength. Two parametric optimizations are pursed iteratively. One is to optimize the matrix parameters to match the simulated wave profile with the measurement. The other is to optimize the polycrystal parameters to match the triaxial stress-strain curves volume-averaged over the polycrystal to those of the matrix. The technique has been applied to analyze the inelastic deformations of shocked alumina and silicon carbide. The results will be presented for demonstration.

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