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Role of pre-existing dislocation loops on the shock compression and spall behavior of FCC metals KE MA, JIE CHEN, GARVIT AGARWAL, AVINASH DONGARE, University of Connecticut — Dislocation loops are ubiquitous in single-crystal and nanocrystalline metals, yet few studies have been devoted to understanding their role on the dynamic behavior of metals. In this work, large-scale molecular dynamics (MD) simulations are carried out to study the role of pre-existing dislocation loops on the shock induced deformation and spall behavior of single-crystal Cu and Al microstructures. This study investigates the role of pre-existing dislocation loops on the wave propagation, dislocation evolution, and void nucleation and growth behavior of single-crystal Cu and Al systems. The results suggest that the presence of dislocation loops results in a decrease of the shock wave velocity, and a substantial decay of the elastic precursor amplitude (HEL) as compared to defect free single-crystal microstructures. The resulting dislocation nucleation and evolution behavior, and void nucleation and growth behavior are also significantly modified due to the presence of dislocation loops. A series of MD simulations are carried out to investigate the effects of the shape (triangular, hexagonal and circular), type (vacancy and interstitial), and density of the dislocation loops for various loading orientations on the spall failure behavior of the metals. The correlations between defect distributions/types/structure and the associated strengthening and weakening behavior will be presented.

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