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Damage Initiation and Evolution in Nanoscale Multiphase Metallic Microstructures Under Shock Loading Conditions at Atomic Scales. MARCO ECHEVERRIA, SUMIT SURESH, SERGEY GALITSKIY, AVINASH DONGARE, University of Connecticut — Materials requirements for next-generation energy, defense, and nuclear applications call for the design and optimization of nanocrystalline multicomponent microstructures using a bottom-up approach. Multiphase metallic materials show promise in this regard due to inherent interfaces that can act as sources or sinks to defects propagation, a mechanism that ultimately determines damage tolerance behavior under shock loading conditions. The response of these interfaces in such extreme environments is observed to vary with the deformability of individual phases, and the creation of damage (void) nucleation sites that initiate spall failure. This study investigates the role of size and distribution of phases on the modifications in the behavior of shock wave propagation, defect evolution, and void nucleation using classical molecular dynamics (MD) simulations. The simulations are carried out to model Al/Si and Al/Ni microstructures and variations in size and distributions of Si/Ni phases in a nc-Al matrix. The MD simulations suggest that void nucleation behavior is observed along the Al/Si and Al/Ni interfaces. The nanoscale links between dislocations, nucleation and growth of voids, and the role these play in the spall strength of an Al/Si and Al/Ni multilayered system are presented.

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