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Unraveling the Effect of Laser Fluence and Loading Orientation on the Spallation of Cu and Al microstructures at Atomic Scales. MARCO ECHEVERRIA, SERGEY GALITSKIY, AVINASH DONGARE, University of Connecticut — The spall response of metals under laser shock loading conditions is investigated using a hybrid approach that combines molecular dynamics (MD) simulations with a continuum two-temperature model (TTM). This hybrid methodology is able to accurately model the laser energy absorption, electron heat conduction, and electron-phonon interaction that results in the ablation/melting of the material and the generation of a shock wave that travels through the metal followed by wave reflections and interactions to initiate spallation failure. The hybrid MD/TTM simulations are carried out to investigate the role of laser fluence on the laser shock loading induced spall failure of single crystal Cu and Al systems for a range of laser fluences from 0.5 to 13 kJ/m2. In addition, MD/TTM simulations are also carried out to investigate the role of loading orientation on the defect/damage nucleation and evolution behavior for Cu and Al single crystal systems. The simulations suggest a correlation between the spall strength and the density of dislocations generated in the metal at the spall plane. The microstructure response and the role of solid-liquid interfaces, defects and voids evolution, and shock wave structure on the spall strength and Hugoniot Elastic Limit of these systems are presented.

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