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Spallation failure study of single crystal nickel under atomistic simulations

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Spallation is a complex failure type that occurs when large tensile stress waves are generated in a specimen due to the interaction of the incident and reflective shockwaves. This phenomenon is governed by multiple factors including material behavior and loading profile and leads to the formation of voids that coalesce to form new surfaces. In this study, a perfect Nickel crystal is photo-excited through picosecond laser pulses using molecular dynamics simulations, and a two-temperature master equation is used to simulate electronic heat conduction. It is seen from our results that the intensity and duration of the laser pulse have a big role in the evolution of void volume, and as well, the critical tensile stress was identified that initiated void growth. Furthermore, the temperature dependence of the critical stress for void nucleation is also discussed. The different factors relating void growth to shockwaves are also highlighted.