Abstract Submitted
for the SHOCK17 Meeting of
The American Physical Society

Atomic Scale Modeling of Laser Shock induced Spallation of FCC Metals SERGEY GALITSKIY, University of Connecticut, CT, DMITRY IVANOV, University of Kassel, Germany, AVINASH DONGARE, University of Connecticut, CT — An atomistic-continuum approach combining the molecular dynamics (MD) simulations with a two temperature model (TTM) was used to simulate the laser induced shock loading and spall failure in FCC metals. The combined TTM-MD approach incorporates the laser energy absorption, fast electron heat conduction, and the electron-phonon non-equilibrium interaction, as well as the shock wave propagation, plastic deformation, and failure processes (spallation) in metals at atomic scales. The simulations are carried out for systems corresponding to dimensions of up to 500 nm in the loading direction for various Cu and Al microstructures and laser loading conditions (intensity and pulse durations). The front end of the metal that absorbs the laser energy is observed to undergo melting and a shock wave is generated that travels towards the rear surface. The shock wave reaches the rear surface, reflects, and interacts with the its tail to create a high triaxial tensile stress region and initiates spall failure (void nucleation). The predicted values of spall strength and wave velocities of shock waves compare very well with experimentally reported values at these dimensions and laser loading conditions. The effect of microstructure and the defect evolution in the system on the predicted spall failure behavior will be presented.

Sergey Galitskiy
Univ of Connecticut - Storrs

Date submitted: 24 Feb 2017 Electronic form version 1.4