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Influence of temperature on spall strength: atomistic simulation

PETER ZHILYAEV, ALEXEY KUKSIN, GENRI NORMAN, VLADIMIR STE-GAILOV, ALEXEY YANILKIN, Joint Institute for High Temperatures of RAS, Moscow, Russia — The shock-wave experiments reveal different influence of temperature on spall strength depending on material microstructure. This work is devoted to study the effect in aluminum using large scale molecular dynamics. Simulations of triaxial deformation, corresponding to stretching in rarefaction waves, and the following fracture is considered. A single crystal with different defects (dislocations, stacking faults, voids) and a polycrystal are modeled. There is considerable difference between behavior of the single crystal and the polycrystal near melting curve. When approaching the melting curve amorphisation of grain boundaries starts. It provides a lower stress barrier to the microcrack propagation. In case of single crystal considerable overheating is observed even in the presence of stacking faults, dislocations and voids. Melting rate depends on temperature and the fracture can start in solid or liquid phase. The comparison with the experimental data on spall strength is carried out. This work was supported by the RAS programs # 11, 12, and SNL under the US DOE/NNSA ASC program.

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