Abstract Submitted
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Shock-induced phase transitions in metals: recrystallization of supercooled melt and melting of an overheated solid VASILY ZHAKHOVSKY, MIKALAI BUDZEVICH, University of South Florida, CARTER WHITE, Naval Research Laboratory, IVAN OLEYNIK, University of South Florida — Steady melting shock waves in aluminum and nickel were studied using a novel moving window molecular dynamics (MW-MD) technique. It was found that shock compression in the [100] crystallographic direction leads to the formation of an overheated metastable solid state within the shock front. This state is located on an extension of the solid branch of the T-P Hugoniot above the melting line. Such an overheated crystal melts behind the shock front accompanied by a temperature decrease. By contrast, the shock compression in the [110] and [111] directions results in a so-called "cold" melting that takes place at a temperature/pressure range below the melting line. Such unusual melting occurs because large shear stresses within the shock front induce an enormous overproduction of defects that transform the crystal to a highly amorphous, liquid-like state. This metastable state, lying on the extension of liquid branch of the T-P Hugoniot below the equilibrium melting line, eventually undergoes a recrystallization associated with a temperature increase and growth of crystal grains in the after-shock flow.

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