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Phase transition effects on dynamic behavior of metals: recent experimental developments and constitutive modeling efforts

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During shock or detonation events, involved metallic structures are subjected to shock and release loadings that induce state or phase transitions along the thermodynamic path, associated with modification of many properties involved in subsequent behavior of the structure. Viscoplastic yielding and damage evolution are concerned. This paper aims at presenting an experimental and modeling methodology, based on experimental data, developed in order to cope with the phase transitioning effect on metals dynamic behavior. Equilibrium Equation Of State (EOS) is identified based on accurate static data under pressure and temperature. Accuracy and relevance of the identification loading path is discussed. The model is then validated through comparison with dynamic data gathered thanks to shock experiments from various initial target temperatures and quasi isentropic experiments. Significant deviations from numerical prediction are analyzed as thermal, kinetics and/or viscoplastic effects. The case of Tin is used as an illustration and applications of the model to spall and microspall damage analysis is addressed.