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Equation of State Effects in Hypervelocity Impact Simulations
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— Hydrocodes are frequently employed to obtain high-fidelity predictions of hypervelocity impacts. The accuracy of these codes in predicting the hydrodynamic characteristics of such impacts, including debris clouds, has been demonstrated over the past 20 years for a variety of applications. However, greater uncertainty is associated with the detailed thermodynamic state of impact-induced debris clouds. Appropriate equations of state (EOSs) are a key factor in predicting these characteristics, including temperature distribution and degree of vaporization. However, significant differences may exist between EOSs in the modeling employed for different phenomena (such as vaporization and ionization), the construction of the liquid-vapor coexistence region, or the density-temperature resolution used to construct the tables. This paper will demonstrate these influences on hypervelocity impact predictions. We will use established computational shock-physics techniques, tabular EOSs, and in-house-developed analysis tools, to analyze impacts on aluminum between 5 and 11 km/s. A better understanding of the observed EOS-related differences will ultimately yield improved models for problems where thermodynamic details of the expanded state are important.

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