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Dynamic strength effects in shock-loaded metals and crystalline explosives[1]

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Multiscale methods show great promise for developing physically-based models of the dynamic behavior of solids under extreme loading conditions. In this approach, the material behavior on a fine scale is described in terms of the actual physical mechanisms/processes. This information is then passed along to descriptions situated at higher length scales, creating a hierarchy that may span from the atomistic level all the way up to the continuum level. Such an approach is appealing because it may lead to predictive modeling capabilities. However, models developed in this way tend to be very complex, involving numerous unknown parameters that are difficult to determine or calibrate from sparse experimental data. In this talk, recent developments pertaining to the dynamic strength of various metals and crystalline explosives will be reviewed, including multiscale model development and methods for extracting strength data from VISAR measurements. Selected calculations will then be presented to demonstrate the importance of strength effects when considering, for example, the temperature-dependence of elastic precursor wave decay, dynamic void growth in tensile waves, and the shear banding and chemical reaction of shock-loaded porous energetic crystals.

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