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Burnett-Cattaneo continuum theory for shock waves BRAD LEE HOLIAN, Los Alamos National Laboratory, MICHEL MARESCHAL, Université Libre de Bruxelles, Belgium, RAMON RAVELO, University of Texas, El Paso, TX — We model strong shockwave propagation, both in the ideal gas and in the dense Lennard-Jones fluid, using a refinement of earlier work, which accounts for the cold compression in the early stages of the shock rise by a nonlinear, Burnett-like, strain-rate dependence of the thermal conductivity, and relaxation of kinetic temperature components on the hot, compressed side of the shock front. The relaxation of the disequilibrium among the three components of the kinetic temperature, namely, the difference between the component in the direction of a planar shock wave and those in the transverse directions, particularly in the region near the shock front, is accomplished at a much more quantitative level by the first-ever rigorous application of the Cattaneo-Maxwell relaxation equation to a reference solution, namely, the steady shockwave solution of linear Navier-Stokes-Fourier theory, along with the nonlinear Burnett heat-flux term. Our new continuum theory is in nearly quantitative agreement with non-equilibrium molecular-dynamics simulations under strong shockwave conditions, using relaxation parameters obtained from the reference solution.

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