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Large-Scale Molecular-Dynamics Studies on the Release of Shocked Polystyrene Under Inertial Confinement Fusion Conditions[1]
SHUAI ZHANG, SUXING HU, University of Rochester — Shock release from inertial confinement fusion (ICF) shells poses a great challenge to single-fluid hydrodynamic equations, especially for describing compounds such as polystyrene. This has been evidenced by a recent experiment [D. Haberberger et al., Phys. Rev. Lett. 123, 235001 (2019)], in which low-density plasmas (10ˆ19 to 10ˆ20 cmˆ-3) are measured to move far ahead of what standard hydro simulations predict. To understand such experimental observations, we have performed large-scale nonequilibrium molecular-dynamics simulations of polystyrene shocked to experimental conditions. These simulations revealed that upon shock release, hydrogen can stream out of the bulk of the CH foil. The released hydrogen, exhibiting a much broader velocity distribution than carbon, forms low-density plasmas moving ahead of the CH shell, which is in quantitative agreement with the experimental measurements. Such kinetic effect of species separation is currently missing in single-fluid radiation-hydrodynamics simulations, which could have profound implication to ICF target designs.

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Shuai Zhang
University of Rochester

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