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The relative role of dispersion, dissipation and inertia in dynamics of martensitic phase boundaries

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Abstract

A fully inertial model of a martensitic phase boundary in a crystal lattice is considered. The model incorporates long-range interactions and covers a broad range of dynamic regimes, from underdamped to overdamped. We study the dependence of kinetics on the degree of discreteness and systematically compare the discrete model with its various continuum and quasicontinuum approximations including elastic, viscoelastic and viscosity-capillarity models. We find that in general, the viscoelastic model provides an upper bound and the viscosity-capillarity model provides a lower bound for the kinetic relation linking the driving force and the phase boundary velocity. While at near-sonic velocities both discrete and continuum models behave similarly, at small velocities, and in particular near the depinning threshold, the predictions of the continuum models cannot be trusted.

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