

Confinement and nonlocal elasticity effects in premelting dynamics

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We study the combined effects of nonlocal elasticity and confinement induced ordering on the dynamics of thermomolecular pressure gradient driven premelted films bound by an elastic membrane. The confinement induced ordering is modeled using a film thickness dependent viscosity (Pramanik & Wettlaufer 2017 Phys. Rev. E 96, 052801). When there is no confinement induced ordering, we recover the similarity solution for the evolution of the elastic membrane, which exhibits an infinite sequence of oscillations (Wettlaufer et al. 1996 Phys. Rev. Lett. 76, 3602-3605). However, when the confinement-induced viscosity is comparable to the bulk viscosity, the numerical solutions of the full system reveal the conditions under which the oscillations vanish. Implications for general thermomechanical dynamics, frost heave observations, and cryogenic cell preservation are discussed.