A Variational Approach to Well-Posedness and Relaxation in Viscoelastic Phase Separation

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Abstract

Viscoelastic phase separation plays an important role in biological cells, for instance, RNA or proteins can undergo phase separation to form membraneless condensates, which is crucial for biological functions. In this talk, we consider a model for phase separation in polymer solutions consistent with the second law of thermodynamics, introduced by Zhou et al. 2006. We neglect the hydrodynamic transport and consider a constant mobility and regular potential. Our primary interest lies in the case of phase-dependent bulk modulus and relaxation time.

Exploiting the gradient structure, we first show the global well-posedness (existence, uniqueness, stability estimate and EDB) of the initial-boundary-value problem for "good enough" initial conditions, tackling the major challenge of failure of semiconvexity and local compactness of the energy. Based on the EDB, we will extend the existence result to initial values living in the energy-domain and the stability estimate to a weak-strong-type. Finally, we address a relaxation limit via evolutionary Γ-convergence. The relaxation time and bulk modulus are assumed to depend on a small parameter, and, depending on the scaling, we can recover the Cahn–Hilliard, the mass-conserving Allen–Cahn or the viscous Cahn–Hilliard equation.

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