Copolymer with pinning: variational characterization of the phase diagram

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Abstract

This paper studies a polymer chain in the vicinity of a linear interface separating two immiscible solvents. The polymer consists of *random monomer types*, while the interface carries *random charges*. Both the monomer types and the charges are given by i.i.d. sequences of random variables. The configurations of the polymer are directed paths that can make i.i.d. excursions of finite length above and below the interface. The Hamiltonian has two parts: a monomer-solvent interaction ("copolymer") and a monomer-interface interaction ("pinning"). The quenched and the annealed version of the model each undergo a transition from a *localized phase* (where the polymer stays close to the interface) to a *delocalized phase* (where the polymer wanders away from the interface). We exploit the approach developed in two recent papers to derive *variational formulas* for the quenched and the annealed free energy per monomer. These variational formulas are analyzed to obtain detailed information on the critical curves separating the two phases and on the typical behavior of the polymer in each of the two phases. Our main results settle a number of open questions.

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