Anisotropic domain growth in the d=3 Ising model with dipolar interactions

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Abstract

Our work focuses on dipolar systems which are ubiquitous, but have received limited theoretical attention. Some examples include alkali hydrides, rare earth fluorides and chlorides, uniaxial ferroelectrics, etc. They are well-represented by the Ising model with dipolar interactions (IM+DI). The latter are long-ranged, anisotropic and can be positive or negative depending on the relative positions of the interacting dipoles. Equilibrium studies have revealed novel consequences of these complicated interactions, but their effect on non-equilibrium aspects is unexplored. We perform, for the first time, a deep temperature quench to study the kinetics of domain growth in IM+DI. Our main observations are: (i) Emergence of elongated domains along the z-axis (Ising axis) with a signature of periodicity in their arrangement in the xy-plane; (ii) Anisotropic domain growth laws with distinct power law exponents in the z-direction and perpendicular to it; (iii) Presence of generalized dynamical scaling signifying that in domain growth the dipolar strength is relevant only upto a scale factor; (iv) Smooth interfaces, as characterised by the Porod law, inspite of the competing ferromagnetic and antiferromagnetic interactions. These observations are relevant for the wide range of experimental systems represented by IM+DI.

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