Theoretical Study on Depining and Coercivity in Nano Ferromagnetic Films

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Abstract

Recently considerable attentions have been paid to domain-wall dynamics in magnetic materials in order to achieve high coercivity. Here we investigate the domain-wall dynamics under driving field in a nano film of permanent ferromagnet by computer simulations on the two-dimensional Ising model with dipole-dipole interactions and random fields. At zero temperature, there is a critical driving magnetic field H_c, below which the system is pinned by random pinning potentials, whereas above which the domain wall acquires a finite velocity. This sharp depinning transition point defines the coercive force. However, velocity is non-zero even below H_c at finite temperatures due to thermal activations. We have found a scaling relation among the velocity, temperature and driving field. As a result, we can evaluate H_c even from data at finite temperatures. Interestingly, the domain-wall motion derived from the scaling function and critical exponents is not a simple Arrhenius-type one [1,2]. An effective energy barrier for domain-wall motion is determined, which governs the domain-wall velocity at finite temperatures, and thus is relevant to the coercive force measured experimentally.

References

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