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Extensions of Kinetic Monte Carlo simulations to study thermally activated grain reversal in dual-layer Exchange Coupled Composite recording media.

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Thermal activation processes represent the biggest challenge to maintain data on magnetic recording media, which is composed of uniformly magnetized nano-meter grains. These processes occur over long time scales, years or decades, and result in reversing magnetization of the media grains by rare events. Typically, rare events present a challenge if modelled by conventional micromagnetic techniques as they are limited to time scales on the order of microseconds even with the best computer resources. A convenient approach that can access long time scales and be able to simulate such rare events processes is the Kinetic Monte Carlo method (KMC). The KMC method computes the time between successive grain reversals induced by an external magnetic field based on an Arrhenius-Neel approximation for thermally activated processes. The KMC method has recently been applied to model single-layer media [1], and we have now extended the method to study dual-layer Exchange Coupled Composition (ECC) media used in current generations of disc drives. A complication to using the KMC method for ECC media is governed by the complex reversal process of coupled grains due to the existence of metastable states. The energy barrier separating the metastable states is obtained from the minimum energy path (MEP) using a variant of the nudged elastic band method [2] and the attempt frequency is calculated based on the Langer formalism [3]. To simplify carrying KMC from single layer media to a dual-layer, we have performed a detailed study for only two coupled grains to help us understand and explore the energy landscape of ECC media and be able to handle the complications associated with ECC media [4]. Applications to study characteristic MH hysteresis loops for multi-grained dual-layered systems is made.

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