Negative Remanent Magnetization of a Single Domain Particle with Two Uniaxial Anisotropies

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An unusual behavior of negative remanent magnetization (NRM), also known as negative coercivity or inverted hysteresis loop, has frequently been reported [1-2]. In most of the previous studies, NRM was explained qualitatively rather than quantitatively which, combined with the observation of the behavior in a complex system, can be an obstacle to gaining a clear understanding of NRM. Recently, however, the authors have demonstrated [1,2] the existence of NRM in a simple and homogeneous system consisting of two uniaxial anisotropies by using detailed energy profiles during the entire field sweep.

Figure 1 schematically illustrates the condition for NRM. Since the value of magnetization (M) in a hysteresis loop is defined as the magnetization component along magnetic field (H) (namely, M cos (α-θ)), NRM only occurs when α-θ >90°. At a sufficiently large value of H, M points to H, i.e., saturation occurs. As the value of H decreases, the energy due to the uniaxial anisotropies begins to appear. In this stage, competition between the counterclockwise torque (τ_1) and clockwise torque (τ_2) determined M rotation direction. If the M rotates initially towards counterclockwise direction ($\tau_1 < \tau_2$), NRM can be occurred when the second uniaxial anisotropy (K_{u2})is not too strong.

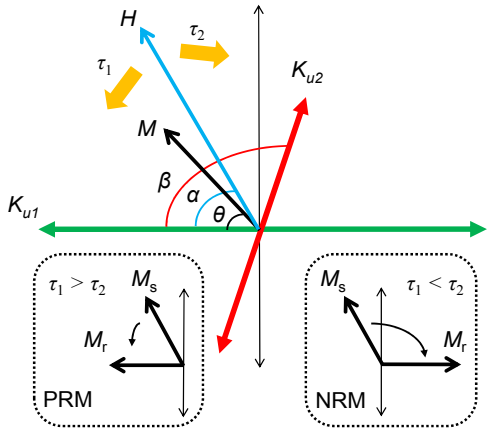

Figure 1. Schematic illustration of the proposed model system with two uniaxial anisotropies, together with a definition of the angles, a, β and Θ. The lower panels show two cases of PRM and NRM, which are mainly determined by the relative strength of the counterclockwise torque (τ_1) and the clockwise one (τ_2) as the value of H decreases from the saturation field.

참고문헌

[1] Y. J. Nam and S. H. Lim, Appl. Phys. Lett. **99** 092503 (2011).
[2] Y. J. Nam and S. H. Lim, Appl. Phys. Express **5** 063002 (2012).