

Stochastic nature of domain nucleation process in magnetization reversal

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Whether domain configurations that occur during magnetization reversal processes on a nanoscale are deterministic or nondeterministic is both fundamentally of great interest and technologically of utmost relevance[1]. However, due to the limited spatial resolution of the microscopic measurement techniques employed so far, no direct observation on the stochastic behavior of local domain nucleation during magnetization reversal in real space at the nanometer scale has yet been reported. In this work, we have investigated a stochastic nature of domain nucleation process during magnetization reversal by utilizing magnetic soft X-ray transmission microscopy with high spatial resolution of 15 nm [2]. The sample used in our study is CoCrPt alloy film, which is the promising candidate for high-density perpendicular magnetic recording media. Typical domain configurations of $(\text{Co}_{83}\text{Cr}_{17})_{87}\text{Pt}_{13}$ taken at an applied magnetic field of 383 Oe during three successive hysteretic cycles are illustrated in Fig. 1.

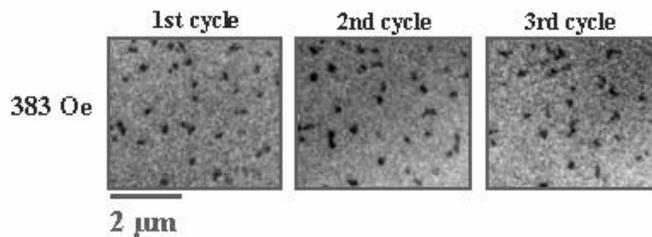


Fig. 1. Magnetic domain configurations of $(\text{Co}_{83}\text{Cr}_{17})_{87}\text{Pt}_{13}$ alloy film taken at an applied magnetic field of 383Oe in the descending branch of the major hysteresis loop

Interestingly enough, one clearly notes that the domain nucleation process of CoCrPt alloy film is not deterministic, but stochastic for repeated hysteretic cycles. The stochastic nature was quantitatively confirmed by correlation coefficient, where the correlation coefficients increase as magnetization reversal was progressed. Nanomagnetic simulations considering thermal fluctuations of the magnetic moments of the grains explains the stochastic nature of the domain nucleation behavior observed in CoCrPt alloy film.

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- [2]. D.-H. Kim, P. Fischer, W. Chao, E. Anderson, M.-Y. Im, S.-C. Shin, and S.-B. Choe,), J. Appl. Phys. **99**, 08H303 (2006)