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Domain wall velocity distribution in Co thin films with in-plane magnetic anisotropy

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An important area of study in thin film magnetism is magnetic switching and domain structure, because magnetization process is, in general, mediated by domain formation and motion. To date, several studies have been performed on domain statics, but few studies have done on domain dynamics.

In this paper, we will present experimental results on in-plane magnetized thin Co films with longitudinal Kerr microscopy. With an applying magnetic field of nearly comparable to the coercivity, 92~98 % of Hc, we could observe magnetization reversal propagated by wall expansion of 180° type domain. Interestingly, magnetization curve shows stepwise feature over whole range of measurement time. Direct domain observation revealed that this behavior was caused by abrupt Barkhausen jumps. We could extract domain wall line information from domain images by image processing. With sequential and simultaneous plot of these wall lines, we found that the Barkhausen jump lengths widely varied from a few micrometers to tens of micrometers. This jump length scale is similar to the recent data reported in other systems.

Reproducibility and/or randomness of these Barkhausen jumps between these pinning sites were also investigated. These pinning effects seemingly related with defects will be discussed with energy argument. Finally, we analyzed velocity distribution of domain wall which can be matched with simulation result by random pinning dominant model.

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