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# 수평자기이방성 Co 박막의 자구 및 자구동역학 연구

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# Study on Magnetic Domain and Domain Dynamics in Co Thin Films with In-Plane Magnetic Anisotropy

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## 1. Introduction

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. We demonstrate that magnetization propagation is mediated by abrupt expansion of domain walls, so called Barkhausen jumps, witnessed via direct domain observation.

## 2. Experiment

Co single-layer samples were prepared by dc sputtering on glass substrates. The base pressure and Ar sputtering pressure were 1.0 x $10^{-6}$ and 1 mTorr, respectively. We varied thickness of Co from 100 to 2000 Å. We used VSM, torque magnetometer, and Kerr spectroscopy to clarify their basic magnetic properties. For domain study, we used longitudinal Kerr microscopy with time resolution better than 30 ms to study dynamic behavior of domains in real time.

## 3. Results and Discussion

As expected, all the prepared samples showed in-plane magnetization, TEM studies revealed polycrystalline structure of the samples. 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[1,2].

Domain wall pinning sites could be seen clearly in Fig. 2. From this figure we could generate, for the first time, a domain wall velocity map corresponding to each point of measurement as

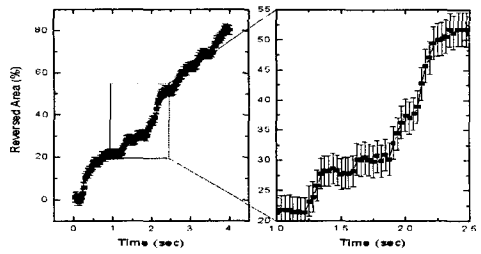


Fig. 1. Barkhausen jumps in magnetization reversal

demonstrated in Fig. 3. 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.

Fig. 2. Domain wall lines with a 30-ms time step for 100x40 pixels

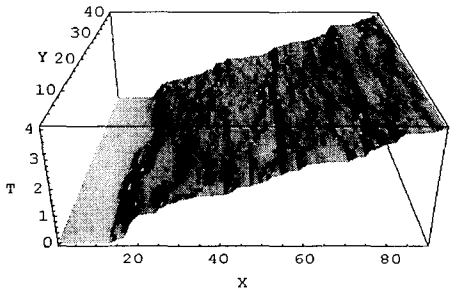


Fig. 3. Velocity map of domain wall with a 30-ms time step

## 4. Conclusion

We directly observed that magnetization reversal in in-plane magnetized Co thin film was mediated mainly by domain wall motion with reproducible Barkhausen jumps. For the first time, we obtained velocity map of domain walls. We found that magnetostatic energy plays an important role in domain wall pinning by defects.

## ACKNOWLEDGEMENT

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## 5. References

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[2] E. Puppin, Phys. Rev. Lett. **84**(23), 5415(2000).