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Effect of Easy Magnetization Axis Orientation Relative to the Strip Direction on Magnetization Reversal in Patterned Permalloy Films

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In an ideal system of ferromagnet, magnetization process is governed by three types of interactions: exchange interaction, magnetocrystalline anisotropy, and magnetic dipolar interactions. We studied the effect of easy magnetization axis orientation with respect to the strip direction on magnetization reversal process in patterned permalloy films of a strip shape by measuring magnetoresistance (MR), magneto-optic Kerr effect (MOKE), and real-time domain evolution. The three strips from a single chip were patterned with the relative orientation of easy axis of each strip being tilted away from the longitudinal direction by 0, 30, and 60 degree, respectively. Figure 1 shows the longitudinal MR ratio of three samples. The field-dependent MR can be explained by the anisotropic magnetoresistance with invoking the magnetization reversal process. The MR ratio significantly increases with increasing angle between two directions, θ, since the magnetization should rotate in larger angles for larger θ toward the easy axis before the magnetization reversal takes place as the applied magnetic field, H, is swept. The magnetization reversal process of low-θ samples involves several MR steps, while the 60-degree MR shows a rather smooth change. The time-dependent MOKE signals and domain structures were taken near the reversal field with the simultaneous MR measurement, and the results showed that the MR steps are associated with the evolution of magnetic domains. The detailed study of MOKE signal, domain structure, and MR as H is rotated away from the strip direction will also be presented and discussed.

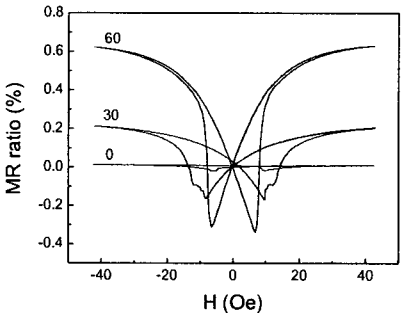

Fig. 1. Magnetoresistance ratio of permalloy films shows the effect of the easy axis orientation relative to the strip direction. The numbers denote the angle between the easy axis and the strip direction.

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Electronic Structure and Magnetism of Rocksalt FeN(001) Surface: A Density Functional Study

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The transition metal nitrides have attracted much attention for their special characteristics such as high-hardness and high-temperature resistance. The experimental and the theoretical studies for these compounds with magnetic transition metals have shown that they have interesting magnetic properties. Kong [1] calculated the band structures and total energies for FeN with the rocksalt (RS), zinc-blended (ZB), and cesium chloride (CsCl) structures and various magnetic phases in order to investigate the phase stability and structure-dependent magnetic properties of FeN. The results showed that the antiferromagnetic (AFM) RS structure with $\mathbf{q}=(0,0,\pi)$ has the lowest energy at the theoretical equilibrium lattice constant, while ZB structure FeN is nonmagnetic and the CsCl structure FeN is ferromagnetic (FM) with a somewhat higher energy compared to the RS one. More recently, Lukashev and Lambrecht [2] investigated the relative energy difference of the RS and ZB structures for FeN and CoN and their magnetism using the LMTO-ASA (linear muffin-tin orbital method in atomic sphere approximation) and full-potential (FP)-LMTO methods. Their spin-polarized calculation showed that the magnetic moment of RS FeN exhibits a sudden jump abovethe minimum-energy lattice constant, while the ZB FeN does not show magnetism.

In this study, we investigated the electronic structure and magnetism of the RS FeN(001) surface. We considered a single slab model consisted of nine atomic layers and calculated the electronic structures for both the FM and AFM configurations using the all-electron full-potential linearized augmented plane wave method (FLAPW) [3] as embodied in the QMD-FLAPW code within the generalized gradient approximation (GGA) [4]. It is found that the AFM phase is more stable than the FM phase, as in the bulk, with an energy difference of 0.14 eV. The magnetic moment of the Fe atoms are 2.90 μ_B, -2.26 μ_B, and 2.37 μ_B for surface (S), subsurface (S-1), and centre (C) layers, respectively, for the AFM phase, while the values are 2.85 μ_B (S), 1.81 μ_B(S-1), and 2.37 μ_B (C), respectively, for the FM one. The calculated layer projected density of states (LDOS) of the FM configuration has a peak at Fermi level (E_F), while that of the AFM configuration has no peak at E_F. This fact implies that the AFM phase is more stable than the FM phase.

REFERENCES

[1] Y. Kong, J. Phys.: Condens. Matter **12**, 4161 (2000).

[2] P. Lukashev and R. L. Lambrecht, Phys. Rev. B **70**, 245205 (2004).

[3] E. Wimmer, H. Krakauer, M. Weinert, and A. J. Freeman, Phys. Rev. B 24, 864 (1981), and references therein; M. Weinert, E. Wimmer, and A. J. Freeman, Phys. Rev. B **26**, 4571 (1982).

[4] J. P. Perdew, K. Burke, and M. Ernzerhof, Phys. Rev. Lett. 77, 3865 (1996); ibid. **78**, 1396 (1997).