Analysis of magnetic properties in patterned micro-NiFe elements with micro-MOKE and micromagnetics

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Understanding and controlling the magnetic properties in mesoscopic ferromagnetic systems is a major challenge for technological applications such as high density storage and magnetic random access memories(MRAMs). Considerable effort has been directed in the last few years at characterizing the magnetization patterns and magnetization reversal processes in patterned elements.[1-4] The patterns were prepared by electron beam lithography on silicon-based substrates. The NiFe films were deposited by DC magnetron sputtering with 50 nm thickness. The magnetic properties of the microfabricated individual elements were investigated by micro-MOKE. The experimentally determined magnetic properties were compared with micromagnetic simulation results. A micromagnetic model utilizing the Landau-Lifshitz-Gilbert equation has been used to investigate the magnetic properties in patterned film elements. In these simulations, we used a saturation magnetization of 800 emu/cm^3, exchange constant of 1×10^{-6} erg/cm, anisotropy constant K_1 of 1×10^3 erg/cm, and damping constant $\alpha = 0.05$. A full hysteresis loop and magnetization configurations of a 8 μm x 16 μm x 50 nm rectangular NiFe element with applied field at 89° to the easy axis are shown in Fig. 1. The saturation field and coercive field were about 100 Oe and 1.9 Oe, respectively. The hard axis coercive field of the disk film with 5 mm diameter was about 0.8 Oe.

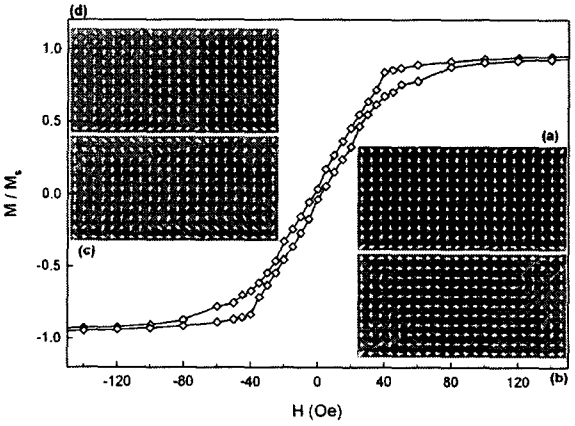

Fig.1. Calculated normalized hysteresis loop of 8 μm x 16 μm x 50 nm rectangular NiFe element with applied field at 89° to the easy axis and magnetization configurations : (a) +120 Oe, (b) 0 Oe, (c) –40 Oe, (d) –120 Oe.

References

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