Study of Magnetostriction in FePtPd

This work studied magnetostriction in $L1_0$ ordered $Fe_{50}Pt_{(50-x)}Pd_x$ alloy thin films with varying Pd content. The measurements of the sputter-deposited films, performed using the cantilever bending technique, indicate that the magnetostriction is dependent on the film composition and a maximum magnetostriction of 28 ppm is found in the $Fe_{50}Pt_7Pd_{43}$ film. These results suggest the possibility of tailoring magnetostriction via film composition for energy assisted data storage and synthetic multiferroic random access memory applications.

FePtPd alloy films, with strong perpendicular magnetic anisotropy, are leading candidates for recording media in next-generation hard disk drives and solid state multiferroic random access memory technologies. The magnetostrictive properties of such materials are of importance, as strain can be used to manipulate their magnetic anisotropy and therefore their magnetic switching characteristics.

The 100 nm thick $Fe_{50}Pt_{(50-x)}Pd_x$ films were deposited on 0.5 mm thick single crystal MgO (100) substrates. The films were prepared by co-sputtering from three independent targets. The sputtering power to the Pd and Pt targets was adjusted to obtain films with different compositions. $L1_0$ ordering was confirmed by X-ray diffraction measurements.

The in-plane and out-of-plane hysteresis loops of the samples were measured by SQUID magnetometry. These confirmed the desired strong perpendicular magnetic anisotropy.

The magnetostriction of the samples was determined using the cantilever bending method illustrated in Fig. 1. The FePtPd film is on the bottom of the cantilevered MgO substrate. To measure the magnetostriction

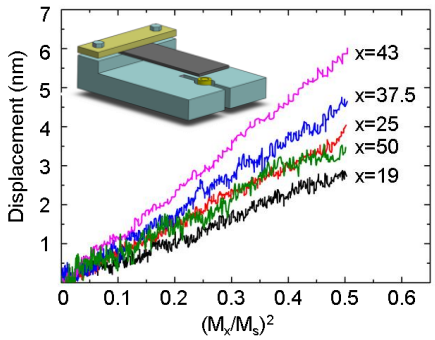

Fig. 1 Illustration of the cantilever bending method for magnetostriction measurement and resulting cantilever displacements plotted as a function of the magnetization for samples of different Pd content, x.

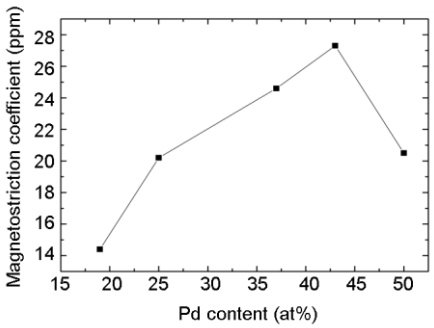

Fig. 2 Magnetostriction coefficient as a function of Pd content for $Fe_{50}Pt_{(50-x)}Pd_x$ thin films.

in the film, an in-plane magnetic field varying from 0 T to 5 T is applied along the cantilever. The dimensional change induced in the film through its magnetostrictive effect results in the deflection of the free end of the cantilever. This displacement is measured by a capacitive displacement sensor and plotted as a function of the magnetization, for films of various compositions in Fig. 1.

Using elastic theory and material properties of the cantilever and film, the magnetostriction coefficient of the films were derived from the displacement data. The magnetostriction coefficients for the FePtPd films are plotted in Fig. 2 with respect to the Pd content of the alloy.

These results have been presented at the 2015 IEEE International Conference on Magnetism and an associated manuscript is currently under review for the IEEE Transactions on Magnetics [1].

References

[1] W. Li, W. Zhou, P. Lenox, T. Seki, K. Takanashi, A. Jander, and P. Dhagat, "Magnetostriction Measurements of L10 $Fe_{50}Pt_{(50-x)}Pd_x$ Thin Films", presented at the IEEE International Magnetics Conference, Beijing, China, May 2015; To be published in IEEE Transactions on Magnetics.

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