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Magnetization Reversal Study of CoCrPt Alloy Thin Films on a Nanogranular Length Scale using Magnetic Transmission Soft X-Ray Microscopy

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CoCrPt alloy films are much attracted as potential materials for high-density recording, since they provide desirable magnetic properties such as high coercivity and strong perpendicular magnetic anisotropy (PMA). In order to achieve high-density magnetic recording media, understanding of the magnetization reversal behavior on a submicron length scale is crucial since it is closely related to the size, irregularity, and stability of written domains [1]. In this work, we have investigated element-specifically the magnetization reversal behavior of a 50 nm thin $(Co_{84}Cr_{16})_{87}Pt_{13}$ alloy films with a lateral resolution of 35 nm using magnetic transmission soft X-ray microscopy [2]. 50 nm thick $(Co_{83}Cr_{17})_{87}Pt_{13}$ alloy films were prepared on a 40 nm thick Ti buffer layer using dc magnetron cosputtering of a CoCr alloy target with Pt chips at a sputtering Ar pressure of 3 mTorr. A 200 nm thick Si_3N_4 membrane was used as substrate in order to allow for sufficiently high transmission of soft x-rays. Magnetization reversal process of the magnetic domain structure was studied by recording MTXM images at the Co L_3 edge in applied external magnetic fields. In Fig. 1, MTXM images taken at subsequent applied magnetic fields are shown together with magnetization data obtained by VSM for the identical sample.

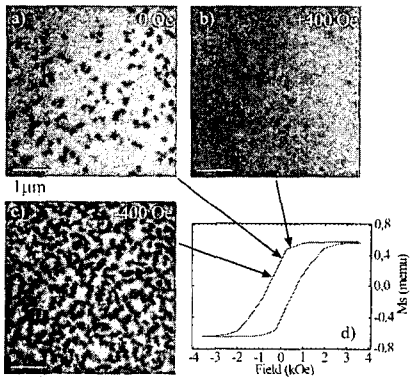

Fig. 1 MTXM images of the magnetic domain structure in a 50-nm thick $(Co_{83}Cr_{17})_{87}Pt_{13}$ alloy film recorded at the Co L3 absorption edge (777eV) in an external field of (a) +400 Oe, (b) 0 Oe and (c) -400 Oe. (d) M vs H hysteresis loop obtained via VSM measurement.

Starting at a fully saturated sample at a large positive field value of +400 Oe (Fig. 1 (b)) corresponding to a fully white contrast in the MTXM image, small nucleation sites can be

observed as dark spots showing up at stochastically distributed positions in the sample. It has to be mentioned that the contrast obtained at the Co absorption edge reflects the element-specific local Co magnetization. Increasing the applied field in negative direction not only single nucleation spots but also contiguous domain structures consisting of more individual dots forming irregular shapes can be seen as shown in Fig. 1 (b) taken for a zero applied field. At -400 Oe (Fig. 1 (c)), which is close to the coercive field these irregular domain structure scenario is dominating. It can be concluded that the magnetization switching in CoCrPt alloy film is carried out by a random nucleation process that can be attributed to individual grains. We also found the evidence of a large distribution of the switching fields on the nanogranular length scale, which has to be considered seriously for applications of CoCrPt systems as magnetic high density storage materials.

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Reference

[1] S.-B. Choe and S.-C. Shin, Phys. Rev. B **57,** 1085 (1998).

[2] P. Fischer, et al., Rev. Sci. Instr., **72**(5), 2322 (2001).