Magnetic Anisotropy and Microstructure in Cr/CoCrPt Hard Disk Films

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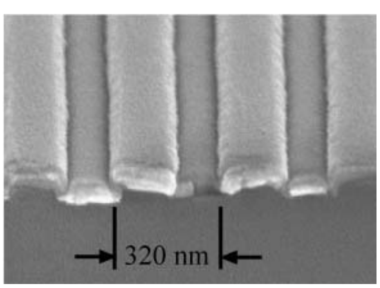
Magnetic CoCrPtTa films on a Cr underlayer are used in hard disks to store data. The films are deposited at temperatures of 200˚C or above, which causes the b.c.c. Cr to grow with a (200) crystallographic texture. The hexagonal Co-alloy grows epitaxially on the Cr with a (11.0) texture, putting its c-axis parallel to the film plane. In such films, the presence of substrate roughness has significant effects on in-plane magnetic anisotropy. In particular, the presence of grooves or scratches in the substrate causes the coercivity, remanence and squareness of the film to be considerably higher parallel to the grooves compared to their values in the perpendicular direction. This effect is useful in hard disks, but the physical origin of this anisotropy is still debated.

We have measured the anisotropy in films deposited onto oxidised silicon substrates with well-controlled submicron surface topography, to explore the origins of the effect and to demonstrate how it can be enhanced by choice of substrate features. Substrates are patterned with shallow, parallel grooves, then coated with Cr/CoCrPt films. Both the stress in the films, and the preferred c-axis orientation, have been characterized. We find that magnetostrictive effects, due to the biaxial stress state of the Co-alloy films, account for about 1/4 of the measured anisotropy. The majority of the anisotropy, however, is caused by a preference for the Co c-axes to lie parallel to the grooves. This is thought to be a result of preferential nucleation of certain Co variants on the biaxially-strained Cr.

We have also been investigating the nucleation and growth of these Co and Cr films, to help understand their morphology and to control grain size for high-density media. This has been done by comparing films grown using pulsed laser deposition to those grown by sputtering. The wide range in available processing parameters allows the importance of factors such as substrate bombardment and surface mobility to be investigated.



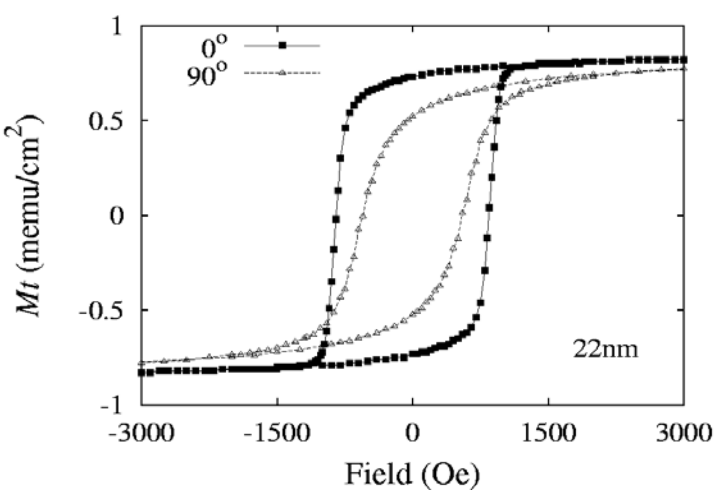


Fig. 10: Left: Example of a film sputtered over a substrate with 320 nm period grooves. Right: Magnetic hysteresis loops from a sample of Cr/CoCrPt sputtered onto a substrate with 200 nm period, 22 nm deep grooves. Coercivity, remanence and squareness are higher parallel to the grooves (filled symbols) compared to perpendicular to the grooves (open symbols).