X-ray magnetic circular dichroism and reflection anisotropy spectroscopy Kerr effect studies of capped magnetic nanowires

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Aligned Co nanowires have been grown on Pt(997) under ultra-high vacuum conditions. Three-atom-wide wires were capped with 3, 6 and 9 ML of Au in a tiled pattern. The samples were kept under vacuum except when transferring between apparatus. No degradation of the Co wires was detected during the measurements, even for the 3 ML Au capping layer. The uncapped 3-wire structure has been studied previously by x-ray magnetic circular dichroism (XMCD) and was found to be ferromagnetic at 10 K and superparamagnetic at 45 K [1]. The easy axis of the uncapped structure lies in a plane orthogonal to the axis of the wire, at -45° to the (111) direction, pointing away from the steps. The normal component of out-of-plane magnetization can be measured using reflection anisotropy spectroscopy (RAS), in a near-normal incidence magneto-optic Kerr effect (MOKE) geometry [2]. Preliminary RAS-MOKE measurements revealed that the capped 3-wire structures were ferromagnetic at 80 K, with an out-of-plane easy axis. XMCD measurements showed that capping with Au, which has large spin-orbit coupling, shifts the easy axis to the (111) direction. Hysteresis studies revealed square loops consistent with coherent rotation being the dominant magnetization reversal mechanism. These results show that capping with Au both raises the Curie temperature and favours perpendicular magnetization of Co nanowires grown on Pt. Both of these findings are of technological significance for magnetic nanostructures.

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