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Characterization of epitaxial Cr thin films

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Abstract content
   (Max 300 words)

Cr and Cr alloys, known for their spin density wave (SDW) antiferromagnetism, exhibit a richness of magnetic phenomena that has attracted considerable interest for many years [1,2]. Thin films and heterostructures of Cr and Cr alloys show fascinating properties, not observed in the bulk material [2,3,4], giving insight into dimensionality effects in these materials [2]. This paper reports on the initial characterization of Cr thin films of thicknesses (t) 20nm to 320nm. These samples were produced using DC magnetron sputtering on MgO(100), MgO(110) and fused silica substrates. X-ray diffraction (XRD) was used to determine the crystallographic orientation of the deposited planes and quality of the films. XRD results showed good epitaxial growth for films prepared on the single crystalline substrates, with Cr(002) and Cr(110) growth obtained in specific growth directions, whilst those prepared on the fused silica were polycrystalline. The mosaicity and coherence length were determined from the XRD results. These properties reveal a general increase in the coherence length and a decrease in mosaicity with increase in t. Standard four-point probe measurements were done to obtain the resistivity (ρ) of the films as function of temperature (<i>T</i>). An anomaly, in the form of a hump was observed in the ρ(<i>T</i>) curves when cooling through the Néel temperature (<i>T</i>_N). This anomaly was used to indicate the magnetic transition temperatures. It has been found that <i>T</i>_N varied as function of thickness with a value of 283 ± 5 K determined for the film with thickness 320 nm. This is in correlation with that obtained in bulk Cr [1], for which the Néel temperature is 311 K [1]. Internal strain effects could be partly responsible for the observed difference in the Néel temperature values between bulk material and the 320 nm thin film [2].

[1] E. Fawcett et al., Rev. Mod. Phys. 66 (1994) 25
[2] H.J. Zabel, J. Phys.: Condens. Matter 11 (1999) 9303
[3] E.E. Fullerton et al., Phys. Rev. Lett. 91 (2003) 237201
[4] R. K. Kummamuru et al., Nature 452 (2008) 859

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