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Electrical properties of Cr_{100-x} Co_x alloy thin films on oriented MgO (100)

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Abstract content
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The magnetic phase diagrams of Cr with group-8 magnetic transition metals Co and Fe exhibits a triple point, where the incommensurate (I) spin density wave (SDW), commensurate (C) SDW and paramagnetic (P) phases converge [1]. Cr-Co alloys has shown considerable promise in practical applications because of its Invar-like properties [2], as well as the fact that Cr/Co multi-layered systems show enhancement of the SDW due to the exchange interaction between the Co moments and the SDW these alloys [3]. This can find application in recording and storage media. Comparison between Cr in bulk and thin film forms revealed dimensionality plays an important role in modifying the SDW structure [4] and this study extends these investigations to include Cr-Co. Epitaxial Cr_{100-x}Co_x thin films of thickness (t) 200nm, with 0 < x < 8, were prepared on MgO(100) substrates using DC magnetron co-sputtering techniques. The epitaxial nature of these monolayers was confirmed using XRD analyses. The resistivity (ρ) for these samples was determined in the temperature range 2K < T < 395K and the temperature associated with the minimum in the dρ/dT versus T curves were used to determine the Néel transition temperatures (T_N) for the individual samples. The T_N versus x plot for this sample series shows that T_N decreases up to 2at.% Co and then increases, reaching a maximum at approximately 6at.% Co. Hall coefficients (R_H) for the films with x = 1 and 4 were determined on cooling from 300K down to 2K, in a constant magnetic field of 5 T. Interestingly, the R_H versus T plots appears to reveal a spin-flip transition at about 100K for 1at.% Co thin film, while it is absent for 4at.% Co sample. The present results will shed light on the effect of dimensionality on the electrical properties of the Cr-Co alloys.

[1] Fawcett E et al. 1994 Rev. Mod. Phys. 66 25
[2] K. Fukamichi et al. 1976 Trans. Jpn. Inst. Metall.. 17 125
[3] Ge S et al. 1988 J. Appl. Phys 63 (8) 4297
[4] Zabel H 1999 J.Phys. Condens. Matter 11 9303

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