Ferromagnetic transitions in Co_2CrAl Heusler alloy films

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Co_2CrAl is a full Heusler alloy that orders into the $L2_1$ or $B2$ structures. Theoretical band structure calculations predict it to be close to half metals with 100 % spin-polarization for both $L2_1$ and $B2$ ordering [1]. Thin films of Fe doped $Co_2Cr_{1-x}Fe_xAl$ alloys have been extensively studied [2] due to a relatively high magnetoresistive effect in pressed powder compacts and magnetic tunnel junctions, while the Co_2CrAl films have been much less investigated.

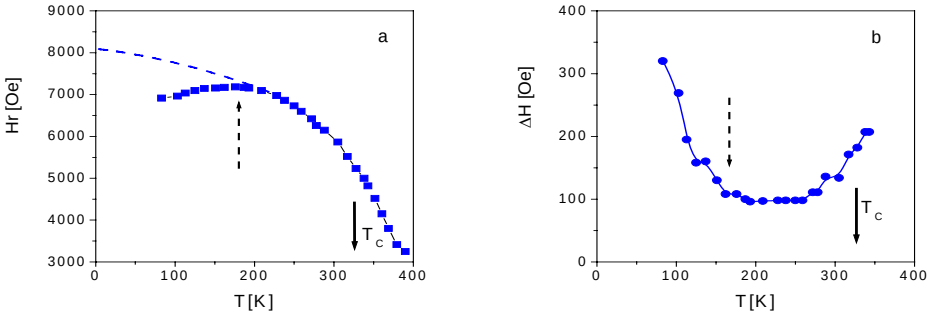

Fig. 1. Temperature dependence of the resonance field (a) measured in the perpendicular configuration and the resonance linewidth (b). The dashed arrows show the onset of antiferromagnetic ordering. The solid arrows show the Curie temperature measured in low magnetic fields.

We report on magnetic properties of Co_2CrAl thin films. Low-field magnetization measurements show that the bulk alloys order ferromagnetically at $T_C \approx 325$ K and below 200 K they exhibit magnetic characteristics typical of antiferromagnetic ordering. Our ferromagnetic resonance (FMR) investigations confirm a complicated magnetic phase-diagram of Co_2CrAl (Fig. 1). FMR measurements suggest the presence of a strong disorder between Co and Cr sites in nominally $L2_1$ or $B2$ structures resulting in: (*i*) antiferromagnetic coupling at low temperatures, (*ii*) the saturation magnetization of 400 G is $\approx 2\mu_B$ per formula unit (f.u.), *i.e.* lower than predicted theoretically 3 μ_B/f.u., (*iii*) the presence of strong ferromagnetic correlations well above the Curie temperature.

[1] Y. Miura *et al.*, Phys. Rev. **69** (2004) 14413
[2] K. Kobayashi *et al.*, Appl. Phys. Lett. **85** (2004) 4684

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