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Magnetic properties of the (Cr_{100-x}Al_x)₉₉V₁</sub> alloy system

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Abstract content
   (Max 300 words)

The magnetic phase diagram of the Cr_{100-x}Al_x alloy system is unique amongst Cr alloy systems because it exhibits a deep minimum at the triple point concentration x_c ≈ 2, where the incommensurate spin-density-wave (SDW) and commensurate SDW phases coexist with the paramagnetic (P) phase [1]. The interesting properties of this system were previously explored by the addition of 5 at.% Mo to form a (Cr_{100-x}Al_x)₉₅Mo₅ alloy system [2]. Antiferromagnetism (AFM) in this system was suppressed to below 4 K in the range 2 ≤ x ≤ 6 [2]. Mo suppresses AFM in Cr and its alloys through electron hole pair breaking effects due to electron scattering [1]. For comparison, the present study investigates the magnetic properties of the Cr_{100-x}Al_x system further through the addition of V. This reduces the AFM in Cr alloys through a mechanism different to that associated with Mo by reducing the electron-to-atom ratio [1]. Electrical resistivity (ρ), Seebeck coefficient (S) and magnetic susceptibility (χ) measurements, as a function of temperature in the range 2 K ≤ T ≤ 390 K, were carried out on the (Cr_{100-x}Al_x)₉₉V₁ alloy system, with 0 < x < 7. Néel temperatures (T_N) obtained from all these measurements decrease with Al concentration, disappearing near x ≈ 1.5, again reappearing for x > 4.5. ρ(T) and S(T) for samples with x ≥ 6.1 show smeared anomalies making the determination of T_N difficult. However, these anomalies are sharp in χ(T), proving that it is an important tool in probing AFM in this system. The present results show that the addition of just 1 at.% V to the Cr_{100-x}Al_x alloy system suppresses AFM in the concentration range 1.5 ≤ x ≤ 4.5. This behaviour is similar to that of the (Cr_{100-x}Al_x)₉₅Mo₅ alloy system [2].

[1] Fawcett E, Alberts H L, Galkin V Yu, Noakes D R and Yakhmi J V 1994 Rev Mod. Phys. 66 25
[2] Smit P and Alberts H L 1986 J. Phys. F: 16 L191

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