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Magnetic properties of the $(\text{Cr}_{100-x}\text{Al}_x)_{99}\text{V}_1$ alloy system

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Abstract content
 (Max 300 words)

The magnetic phase diagram of the $\text{Cr}_{100-x}\text{Al}_x$ alloy system is unique amongst Cr alloy systems because it exhibits a deep minimum at the triple point concentration $x \approx 2$, 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 $(\text{Cr}_{100-x}\text{Al}_x)_{95}\text{Mo}_5$ alloy system [2]. Antiferromagnetism (AFM) in this system was suppressed to below 4 K in the range $2 \leq x \leq 6$ [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 $\text{Cr}_{100-x}\text{Al}_x$ 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 $2 \text{ K} \leq T \leq 390 \text{ K}$, were carried out on the $(\text{Cr}_{100-x}\text{Al}_x)_{99}\text{V}_1$ alloy system, with $0 < x < 7$. Néel temperatures (T_N) obtained from all these measurements decrease with Al concentration, disappearing near $x \approx 1.5$, again reappearing for $x > 4.5$. $\rho(T)$ and $S(T)$ for samples with $x \geq 6.1$ show smeared anomalies making the determination of T_N difficult. However, these anomalies are sharp in $\chi(T)$, 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 $\text{Cr}_{100-x}\text{Al}_x$ alloy system suppresses AFM in the concentration range $1.5 \leq x \leq 4.5$. This behaviour is similar to that of the $(\text{Cr}_{100-x}\text{Al}_x)_{95}\text{Mo}_5$ 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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