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Hall Coefficient of (Cr100-xAlx)95Mo5 Alloy System

Hall coefficient (<i>R</i>_H) measurements have shown to be an effective method in determining the number density, <i>n</i>=(q<i>R</i>_H)⁻¹, and the type of majority charge carriers at the Fermi surface (FS) [1-3] of Cr and its alloys. Parts of the Fermi surface sheets that are annihilated during antiferromagnetic (AFM) ordering in Cr based alloys have large effects on the number density resulting in an anomalous behaviour on cooling below the Néel transition temperature, <i>T</i>_N [4]. Previous studies on the (Cr_{100-<i>x</i>}Al_{<i>x</i>})₉₅Mo₅ alloy system through electrical resistivity (<i>rho;</i>), Seebeck coefficient (<i>S</i>), thermal conductivity (<i>kappa;</i>), specific heat <i>C</i>_p , magnetic susceptibility (<i>chi;</i>) and neutron diffraction measurements have shown that antiferromagnetism is suppressed in the concentration range 1.4 ≤ <i>x</i> ≤ 4.4 [5]. The present study was undertaken in order to extend the previous findings on this alloy system, through Hall coefficient measurements. <i>R</i>_H of polycrystalline (Cr_{100-<i>x</i>}Al_{<i>x</i>})₉₅Mo₅ alloys was measured over the temperature range 2 K ≤ <i>T</i> ≤ 380 K in a magnetic field of 4.5 T. Anomalies in the form of an upturn were observed just below the <i>T</i>_N for the AFM alloys with <i>x</i> ≤ 1.3 and <i>x</i> ≥ 5.3. In addition to these anomalies, alloys with <i>x</i> = 0, 0.5, 0.9 and 8.6 show a peculiar behaviour below <i>T</i>_N, in which <i>R</i>_H increases and then decreases depicting a hump on further cooling. Remarkably <i>R</i>_H for the alloy with <i>x</i> = 0 shows a sign reversal of majority charge carriers from holes to electrons on cooling below 120 K. The crossover of majority charge carriers disappears by the addition of just 0.6 at.% Al into the alloy with <i>x</i> = 0. The behaviour of alloys with <i>x</i> = 0, 0.5, 0.9 and 8.6 is explained in terms of the two band model in which both charge carriers contribute to magneto-transport properties [6]. The relative magnetic contribution to the Hall coefficient, Delta;<i>R</i>_{H(2K)}/<i>R</i>_{H(2K)} indicate a suppression of antiferromagnetism in the concentration range 1.7 ≤ <i>x</i> ≤ 4.7.

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