ANOMALOUS GALVANOMAGNETIC PROPERTIES IN THE CHARGE DENSITY WAVE STATE OF $K_{0.9}MO_6O_{17}$

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Abstract

Hall effect measurements, performed on $K_{0.9}Mo_6O_{17}$ single crystals, show a large increase of the Hall constant at low temperature. They are consistent with a gap opening taking place below ≈ 30 K and possibly due to a spin density wave instability.

1 - Introduction

$K_{0.9}Mo_6O_{17}$ is a quasi two-dimensional metal which shows a Fermi surface instability at $T_p = 120$ K towards a commensurate metallic charge density wave (CDW) state (1). In the CDW state, the magnetic susceptibility shows, for magnetic field perpendicular to the 2 D layers a minimum at ≈ 70 K and a maximum at $T_a \approx 20$ K suggesting the existence of a spin density wave instability (2). Magnetoresistance data show a low temperature anomaly (maximum on the curve of $\rho(T)$) which develops under magnetic field : this corroborates that the instability taking place at $T_a \approx 20$ K in zero field is field dependent and displaced towards higher temperature under magnetic field (3). Electrical resistivity studies performed at lower temperatures (down to 18 Tesls), also show quantum oscillations indicating field induced Fermi surface instabilities (4). A phase diagram showing three branches related to three instabilities has been proposed (3,4). We now report Hall effect studies obtained in low fields between 4.2 K and 40 K which corroborate the existence of an instability at Ta.

2 - Experiment

The single crystals used in this study are grown by the electrocrystallization technique. They are in shape of platelets perpendicular to the c-trigonal axis. Hall effect

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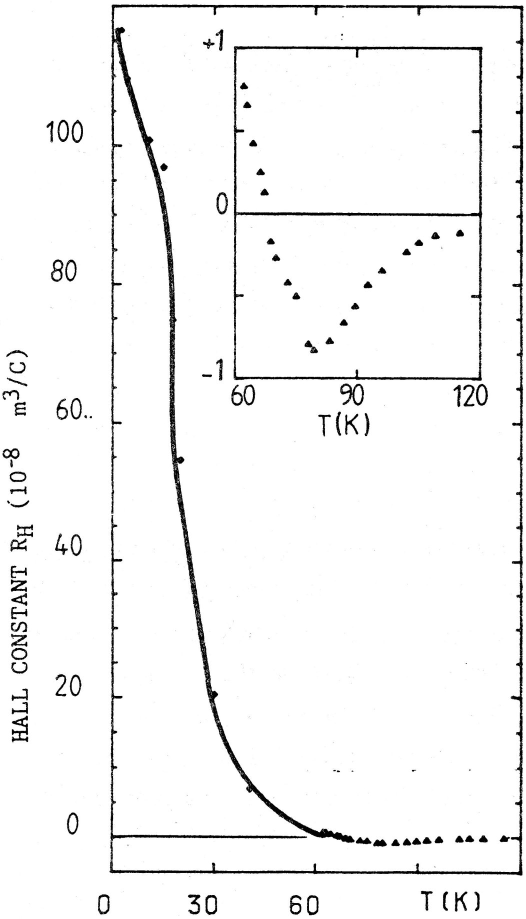

Figure 1 : Hall constant as a fonction of temperature (I // ab plane, B // c). The high temperature (T > 60 K) data shown also in the inset are from ref. 5.

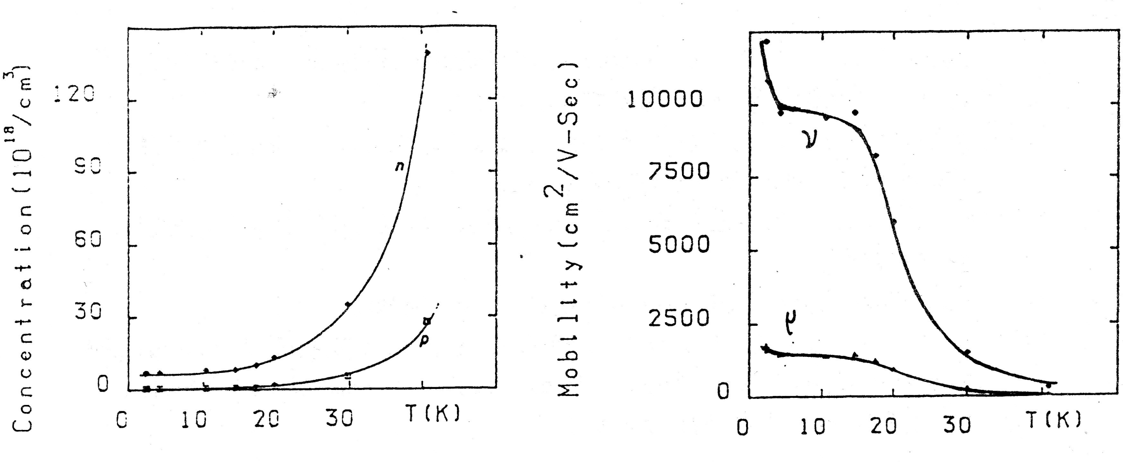

Figure 2 : Carrier concentrations (a) and mobilities (b) vs temperature, obtained from combined Hall effect, electrical resistivity and magnetoresistance data (ref 4).

has been measured between 4.2 K and 40 K with d c current parallel to the a-b plane and magnetic field parallel to the c-axis. Figure 1 shows the Hall constant R_H as a function of temperature. The high temperature (T > 60 K) data, reported previously in ref. 4, show a large increase of $|R_H|$ below the Peierls transition T_p and a maximum at ≈ 80 K. The Hall constant changes sign at ≈ 70 K and increases steeply below ≈ 40 K. Figure 2 shows the carrier concentrations and mobilities, as-obtained with a two-band model using combined data of electrical resistivity, magnetoresistance (see ref 3 and 4) and Hall effect. Both the electron and hole concentrations decrease steeply below ≈ 40 K.

3 - Discussion and conclusion

Hall effect data are consistent with two electronic instabilities, the high temperature CDW one at T_p ≈ 120 K.and a low temperature one taking place below ≈ 30 to 40 K. The decrease of carrier concentrations corroborates that a second gap opens at low temperature, as suggested by magnetic susceptibility data. The Hall effect results, together with the magnetic properties, therefore support the existence of a spin density wave instability at low temperature in $K_{0.9}Mo_6O_{17}$. Experiments on the low temperature and high field galvanomagnetic properties of the low temperature state are presently on progress.

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