The effect of high pressures on the magnetic properties of chromium tellurides

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On the basis of experimental investigations (Grazhdankina *et al.*, 1961) of the Curie temperature T_C of chromium telluride CrTe and of the solid solutions $CrTe_{1-x}X_x$ (where X = S, Se, or Sb) under high pressures it could be expected that two mechanisms of exchange coexist in chromium tellurides: (i) indirect antiferromagnetic (AF) exchange of localised electrons via the nonmagnetic ion, and (ii) interaction of shared electrons in the narrow 3d band; the energy of the latter is dominant and governs the value of T_C.

To establish the validity of this hypothesis we have investigated chromium telluride in which a monoclinic distortion of the unit cell was produced by heat treatment. The distortion results in the enhancement of the AF-superexchange and the appearance of noncollinear magnetic structure at low temperatures. In this case the alloy has a magnetic phase transformation at the temperature of T_s = 110 K connected with the transition of the noncollinear magnetic structure into a ferromagnetic one, and a maximum is observed in the temperature dependence of the magnetisation curve, $\sigma(T)$ (Grazhdankina *et al.*, 1974).

The results of measurements of magnetisation under pressures up to 13 kbar are shown in figure 1. Figure 2 shows the dependence of T_C and T_s on pressure. It can be seen that at $T < T_s$ the value of σ decreases with increasing pressure and the derivatives dT_s/dP = 6 K kbar^{-1} and $dT_C/dP = -5\cdot9$ K kbar^{-1} are of opposite sign. These results can be interpreted in terms of the coexistence of the two aforementioned exchange mechanisms. According to Goodenough (1968) AF superexchange increases with pressure since the latter causes an increase of the transfer integral b and the AF exchange energy is proportional to b^2. This leads to an increase of T_s and a decrease of σ with increasing pressure. The decrease of T_C with increasing pressure is due to a change of the interaction between the electrons in the narrow 3d band. The large negative value of dT_C/dP is caused by the decrease of electron density near the Fermi surface connected with the increase of the bandwidth at high pressures.

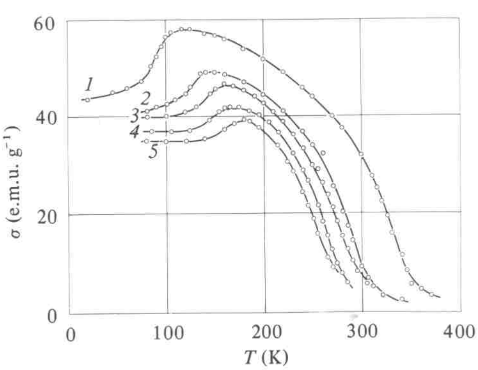

Figure 1. Temperature dependence of specific magnetisation of CrTe in a field of 8 kOe at hydrostatic pressures of: *1* 0 kbar; *2* 5·8 kbar; *3* 0·3 kbar; *4* 11·4 kbar; *5* 12·9 kbar.

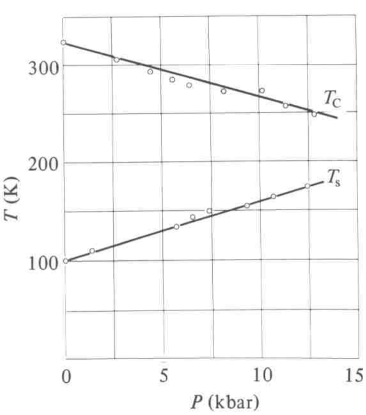

Figure 2. Pressure dependence of magnetic transformation temperatures T_C and T_s in chromium telluride.

References

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Investigation of the phase transition in magnesium stannide under hydrostatic pressure by the Mössbauer effect and electric resistance

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We are reporting here preliminary results of an investigation of the phase transition in Mg_2Sn under hydrostatic pressure, with benzine as the pressure transmitting medium. Our results disagree with the data of Möller (1968) who used Bridgman anvils. Electric resistance measurements show that the experimental results depend on the type of the applied pressure (figure 1). The same is found with the Mössbauer method. With Bridgman anvils (Möller, 1968) a single Mössbauer line is obtained at each pressure; under hydrostatic pressure a broadening and asymmetry of Mössbauer Mg_2Sn lines are observed in the pressure region 30–47 kbar. x-Ray data (Dyuzheva *et al.*, 1972), indicate that the pressure range 25–50 kbar corresponds to a two-phase Mg_2Sn system where the new and the old phases coexist.

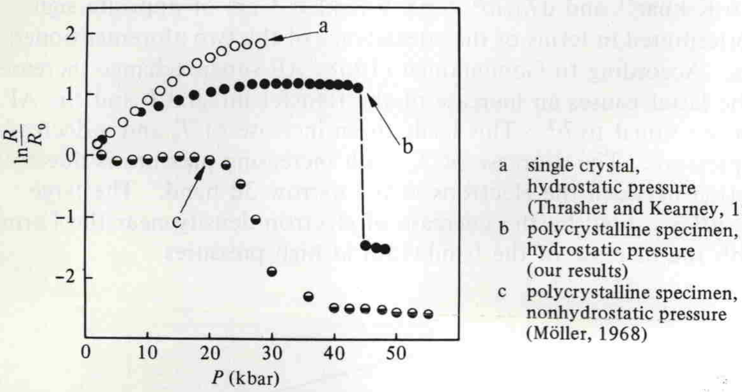

Figure 1. Pressure dependence of the electric resistance of Mg_2Sn under different conditions.

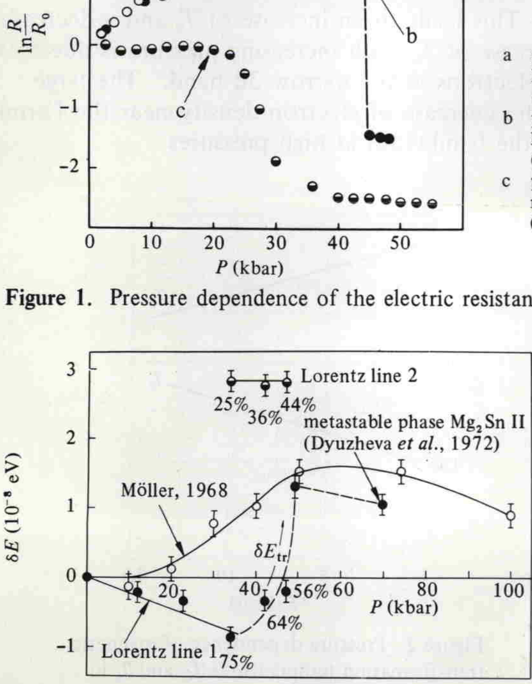

Figure 2. Shift of the Mössbauer lines, δE, for Mg_2Sn under pressure. The percentages shown relate to the areas of lines 1 and 2.