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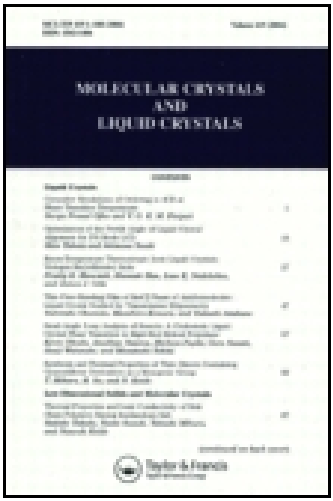

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Magneto Transport and EPR Measurements on $(TSeT)_2$ Br

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MAGNETO TRANSPORT AND EPR MEASUREMENTS ON $(TSeT)_2Br$.

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Abstract We report resistivity and magnetoresistance measurements under pressure down to 0.1 K and EPR experiment at 1 bar on $(TSeT)_2Br$ prepared by an electrochemical method. The compound is known to undergo a phase transition at 293 K as a function of pressure leading to two conducting phases: a low and a high pressure phase. In the latter at low temperature the metallic state is stabilized under high pressure. In spite of large residual resistivity ratio (RRR), no sign of superconductivity has been detected down to 0.1 K. Transverse magnetoresistance experiments at 6 Kbar show very weak quadradic field dependence and no saturation up to 70 KG.

INTRODUCTION

TSeT halides have interesting organo-metallic properties which [1] seem very sensitive to synthesis and crystallisation conditions[2]. Namely, they are strong π donor molecules with 26 π electrons and the salts have high room temperature conductivities of the order of $2.10^3(\Omega cm)^{-1}$. A metal-to-semimetal transition occurs at 1 bar at low temperature. On high quality crystals EPR measurements may reveal whether impurity spins exist in addition to the conduction electrons. In the high pressure phase, taking into account the large RRR observed, it was interesting to measure R(T) dependence down to 0.1 K in order to see whether or not $(TSeT)_2Br$ is a superconductor. High field galvanomagnetic behaviour can lead to some information about the topology of the Fermi surface.

EXPERIMENTAL AND RESULTS

$(TSeT)_2Br$ crystals were grown by electro-crystallization in THF. The electrolyte solution and TSeT were analysed by X-ray fluorescence with respect to chlorine and iodine concentration, giving an upper limit of 100 ppm for chlorine versus 50 ppm iodine concentration in $(TSeT)_2Br$ crystals. By EPR experiments at 9.4 GHz, the sample signal was too weak and its linewidth too large to be detected. Below 48 K, an EPR linewidth was found to be constant ($\Gamma_{ex} \propto \sim 118 \pm 8$ G) versus T while the intensity $\propto T^{-1}$, probably resulting from impurities.

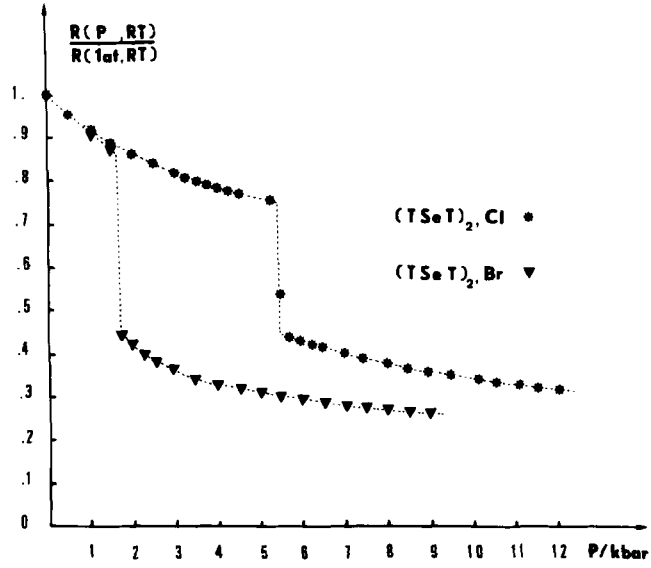

FIGURE 1 Four probe 80 Hz a.c.resistivity measurements along the highly conducting axis versus pressure at 293 K for $(TSeT)_2Br$ and $(TSeT)_2Cl$.

In addition at 4.2 K, the RRR values were 75 at 6 Kbar for the former and 100 at 10 Kbar for the latter on the purest samples [3].

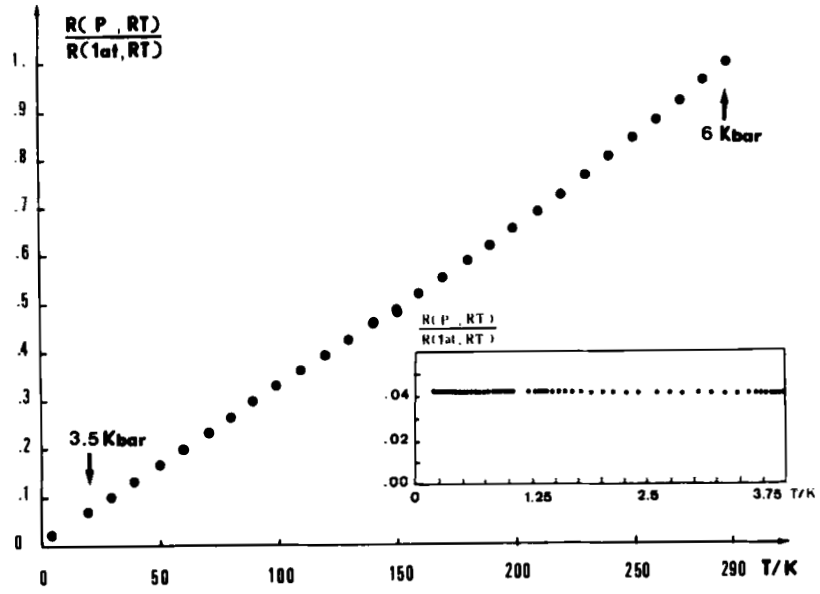

FIGURE 2 The stabilization of the metallic state down to 0.1 K is shown in the high pressure phase of $(TSeT)_2Br$, with a residual resistivity ~ 5 $\mu\Omega$cm. A temperature above 30 K a resistivity depending as $\rho \propto T^{1.1}$ was found at 4 Kbar.

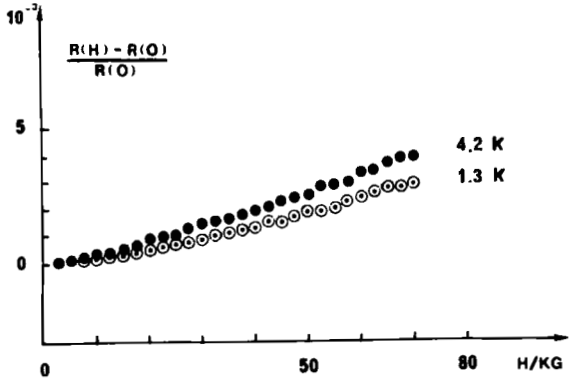

FIGURE 3 Transverse magnetoresistance measurements at 6Kbar reveal a very weak enhancement $\propto H^2$ without saturation up to 70 KG at 4.2 and 1.3 K.Similar dependence is obtained at 3.5Kbar and 0.1K.

CONCLUSION

At ambient pressure the conduction band is 3/4 filled; following Shchegolev[1], the low temperature transition may be associated with a modification of the energy spectrum which prevents a pure Peierls transition. The 3-D coupling may be stronger in $(TSeT)_2Br$ than in other conducting salts such as $(TMTSF)_2X$. This may explain why the $(TSeT)_2Br$ response in EPR is much more like the one of a classical metal. An other possibility is that the absorption coming from impurities masks the intrinsic behaviour of the compound. However, the anisotropy of the conductivity of the order of 10^{-2} leading to $t_\perp/t_{//} \sim 10^{-1}$ is in favour of an open Fermi surface[4]. As far as high magnetic field effects are concerned, the quadratic behaviour associated with unsaturated transverse magnetoresistance requires an open orbit in one direction. Furthermore, we cannot exclude the possibility of a change in scattering processes due to a partial polarization of the spin as has already been suggested[1].

In any case, the crucial problem of the unique pressure phase transition which occurs at room temperature must be solved by X-ray studies of the structure in the low and high pressure phases. If a structural phase transition is involved, we should look at the transport properties with new eyes.

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3. In the mean time we have produced small crystals of $(TSeT)_2Br$, (1,5x0,03x0,03 mm^3) which give a value of R(38K)/R(295K)=0,06 at ambient pressure,by further eliminating the chlorine contamination to the new upper limit of 50 ppm.
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