

This article was downloaded by: [Tomsk State University of Control Systems and Radio]

On: 20 February 2013, At: 12:38

Publisher: Taylor & Francis

Informa Ltd Registered in England and Wales Registered Number: 1072954

Registered office: Mortimer House, 37-41 Mortimer Street, London W1T 3JH, UK



Molecular Crystals and Liquid Crystals

Publication details, including instructions for authors and subscription information:

<http://www.tandfonline.com/loi/gmcl16>

Magneto Transport and EPR Measurements on (TSeT)₂ Br

C. Weyl^a, L. Brossard^a, S. Tomić^a, D. Mailly^a, D. Jerome^a, B. Hilti^b & C. W. Mayer^b

^a Laboratoire de Physique des Solides, 91405, Orsay, France

^b Zentrale Forschungslaboratorien CIBA GEIGY, CH 4002, BASEL

Version of record first published: 17 Oct 2011.

To cite this article: C. Weyl, L. Brossard, S. Tomić, D. Mailly, D. Jerome, B. Hilti & C. W. Mayer (1985): Magneto Transport and EPR Measurements on (TSeT)₂ Br, Molecular Crystals and Liquid Crystals, 120:1, 263-266

To link to this article: <http://dx.doi.org/10.1080/00268948508075799>

PLEASE SCROLL DOWN FOR ARTICLE

Full terms and conditions of use: <http://www.tandfonline.com/page/terms-and-conditions>

This article may be used for research, teaching, and private study purposes. Any substantial or systematic reproduction, redistribution, reselling, loan, sub-licensing, systematic supply, or distribution in any form to anyone is expressly forbidden.

The publisher does not give any warranty express or implied or make any representation that the contents will be complete or accurate or up to date. The accuracy of any instructions, formulae, and drug doses should be independently verified with primary sources. The publisher shall not be liable

for any loss, actions, claims, proceedings, demand, or costs or damages whatsoever or howsoever caused arising directly or indirectly in connection with or arising out of the use of this material.

MAGNETO TRANSPORT AND EPR MEASUREMENTS ON (TSeT)₂Br.

C.WEYL, L.BROSSARD, S.TOMIĆ, D.MAILLY and D.JEROME
 Laboratoire de Physique des Solides, 91405 Orsay, France

and

B.HILTI, C.W.MAYER, Zentrale Forschungslaboratorien
 CIBA GEIGY, CH 4002 BASEL

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 quadratic field dependence and no saturation up to 70 KG.

INTRODUCTION

TSeT halides have interesting organo-metallic properties which¹ seem very sensitive to synthesis and crystallisation conditions². Namely, they are strong π donor molecules with 26 π electrons and the salts have high room temperature conductivities of the order of $2.10^3(\Omega\text{cm})^{-1}$. 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 ($\Gamma_{\text{ex}} \propto 118 \pm 8$ G) versus T while the intensity $\propto T^{-1}$, probably resulting from impurities.

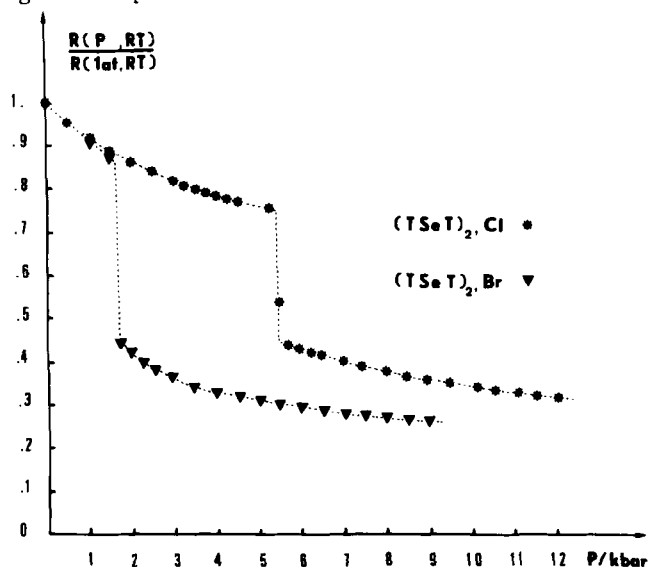


FIGURE 1 Four probe 80 Hz a.c.resistivity measurements along the highly conducting axis versus pressure at 293 K for (TSeT)₂Br and (TSeT)₂Cl.

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.

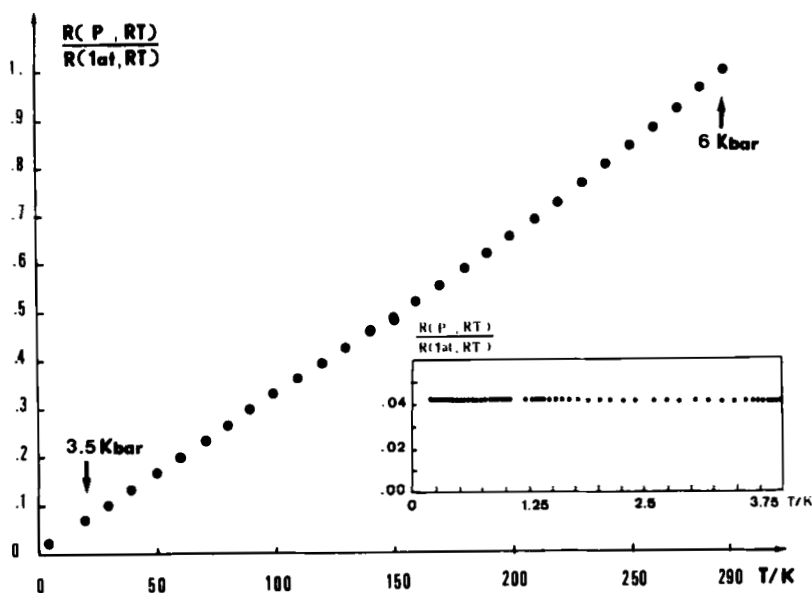


FIGURE 2 The stabilization of the metallic state down to 0.1 K is shown in the high pressure phase of $(\text{TSeT})_2\text{Br}$, with a residual resistivity $\sim 5 \mu\Omega\text{cm}$. A temperature above 30 K a resistivity depending as $\rho \propto T^{1.1}$ was found at 4 Kbar.

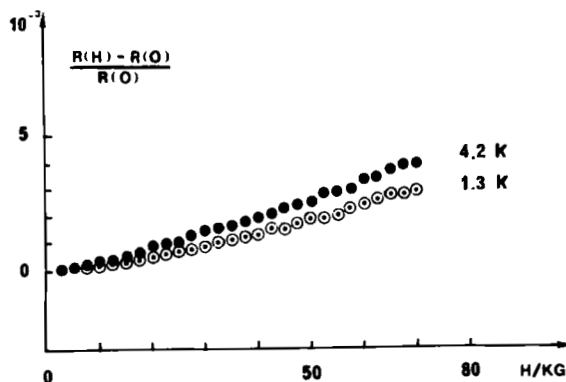


FIGURE 3 Transverse magnetoresistance measurements at 6Kbar reveal a very weak enhancement $\propto H^2$ without saturation up to 70 KG at 4.2 and 1.3 K. Similar dependence is obtained at 3.5Kbar and 0.1K.

CONCLUSION

At ambient pressure the conduction band is 3/4 filled; following Shchegolev¹, 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 $(\text{TSeT})_2\text{Br}$ than in other conducting salts such as $(\text{TMTSF})_2\text{X}$. This may explain why the $(\text{TSeT})_2\text{Br}$ 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 $t_{\perp}/t_{\parallel} \sim 10^{-1}$ is in favour of an open Fermi surface⁴. 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 suggested¹.

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.

REFERENCES

1. I.F.Shchegolev, E.B. Yagubskii, Extended linear chain compounds 2, Chap.9, p.385, Ed MILLER.
2. P.A.Kononovich, V.N.Laukhin, S.I.Pesotskii, F.F.Shchegolev and A.G.Khomenko, JETP Lett., 37, 92 [1983].
3. In the mean time we have produced small crystals of $(\text{TSeT})_2\text{Br}$, $(1.5 \times 0.03 \times 0.03 \text{ mm}^3)$ which give a value of $R(38\text{K})/R(295\text{K})=0.06$ at ambient pressure, by further eliminating the chlorine contamination to the new upper limit of 50 ppm.
4. P.M.Chaikin, Mu-Yong Choi and R.L.Greene, J.Phys.Colloque C3, 44, 783, [1983].