Electrical conductivity of $(TSeT)_2Cl$ at temperatures below 1 K

V. B. Ginodman, L. N. Zherikhina, and E. E. Yurchakevich
P.N. Lebedev Physics Institute, USSR Academy of Sciences

(Submitted 21 July 1979)
Pis'ma Zh. Eksp. Teor. Fiz. **30**, No. 5, 290–292 (5 September 1979)

We investigated the electrical conductivity of a single-crystal sample of an organic quasi-one-dimensional metal $(TSeT)_2Cl$ in the temperature range 0.4–300 K. The transition to superconducting state was not observed in this temperature range.

PACS numbers: 72.80.Le

At present, a very small number (2–3) of organic compounds of quasi-one-dimensional type, which have the properties of a metallic conductor down to helium temperatures, are known. These compounds include the TCNQ group with HMTSeF[1] and the $(TSeT)_2Cl$ [and the isostructural compounds $(TSeT)_2Br$ and $(TSeT)_2I$]. The

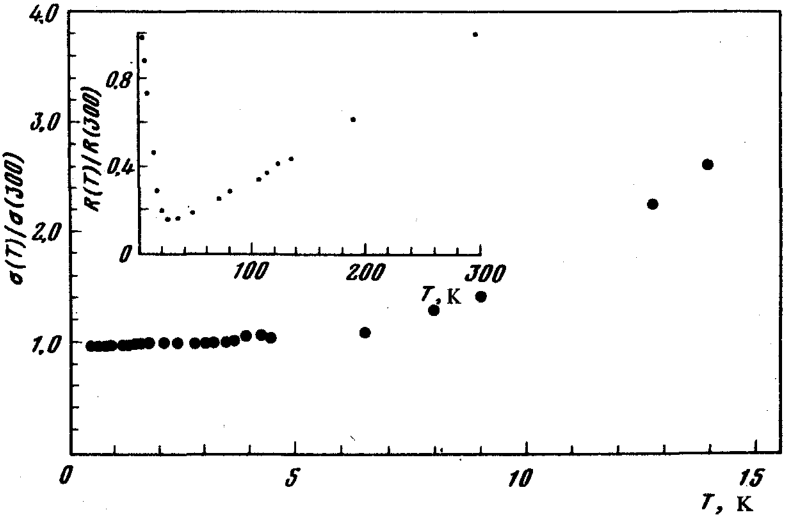

FIG. 1. Temperature dependence of the conductivity for a single-crystal $(TSeT)_2Cl$ sample; the inset shows the temperature dependence of the resistance in a wide range of temperatures from 4 to 300 K for $(TSeT)_2Cl$.

method of obtaining $(TSeT)_2Cl$, its crystal structure, and basic properties are described in Refs. 2–5.

The crystalline structure of this compound, typically quasi-one-dimensional, is characterized by the presence of TSeT molecules which are extended along the *C* axis. The room conductivity along this direction, which is $2.1\times10^3\ \Omega^{-1}\cdot cm^{-1}$, increases with decreasing temperature to 26 –27 K; the magnetic susceptibility in this temperature range is almost independent of temperature. On further reducing the temperature the resistance begins to increase and reaches values corresponding to room temperature at 4 –5 K. At lower temperatures, the resistance is constant and independent of temperature.

Taking into account that $(TSeT)_2Cl$ remains in the metallic state down to helium temperatures, it was of interest to measure the $R(T)$ dependence of a single-crystal sample of $(TSeT)_2Cl$ to very low temperatures in order to determine whether or not this material goes superconducting.

Zolotukhin *et al.*[3] measured the conductivity of a $(TSeT)_2Cl$ sample in the shape of a compressed tablet down to a temperature of 0.1 K; however, it was impossible to determine unambiguously on the basis of these experiments whether there was a superconducting transition in it.

The results of our experiments are shown in Fig. 1. The inset shows the variation of the relative resistance as a function of temperature in the range from 300 to 4 K. In terms of the position of the minimum and of the values of $R(T)/R(300)$ at a temperature corresponding to the minimum on the curve and at $T = 4.2$ K, this dependence is in good agreement with that given in Ref. 3.

The main part of Fig. 1 shows the variation of $\sigma(T)/\sigma(300)$ as a function of temperature in the region of low temperatures. It can be seen in Fig. 1 that at temperatures below 4 K the conductivity is almost independent of the temperature and is close to that at room temperature.

Thus, it can be concluded that there is no superconducting state in $(TSeT)_2Cl$ to a temperature of 0.4 K.

The authors thank I.F. Shchegolev, É.B. Yagubskiĭ, and L.I. Bulaevskiĭ for providing the $(TSeT)_2Cl$ samples and for discussing the results of this paper, and also A.B. Fradkov for his interest in this work.

[1]G. Soda, D. Jerome, M. Weger, K. Bechgaard, and E. Pederson, Solid State Comm. **20**, 107 (1976).
[2]L.T. Buravov, A.I. Kotev, M.L. Khidekel; I.F. Shchegolev, and E.B. Yagubskiĭ, Jzv. Akad. Nauk SSSR, Ser. Khim., 475 (1976) [Bull. Acad. Sci. USSR Chem. Ser., (1976)].
[3]S.P. Zolotukhin, V.F. Kaminskiĭ, A.I. Kotov, R.B. Lyubovskiĭ, M.L. Khidekel', R.P. Shibaeva, I.F. Shchegolev, and E.B. Yagubskiĭ, Pis'ma Zh. Eksp. Teor. Fiz. **25**, 480 (1977) [JETP Lett. **25**, 451 (1977)].
[4]V.N. Laukhin, A.I. Kotov, M.L. Khidekel, I.F. Shchegolev, and E.B. Yagubskiĭ, **28**, 284 (1978) [JETP Lett. **28**, 260 (1978)].
[5]S.P. Zolotukhin, Yu. S. Karimov, and I.F. Shchegolev, Zh. Eksp. Teor. Fiz. **76**, 377 (1979) [Sov. Phys. JETP **44**, (1979)].