RESISTIVITY AND MAGNETORESISTANCE OF THE ORGANIC SUPERCONDUCTOR $\beta(BEDT\text{-}TTF)_2I_3$ AT AMBIENT PRESSURE FOR CURRENT FLOW ALONG THE C* AXIS

J.R. COOPER[+], L. FORRO[+] and D. SCHWEITZER[++]

[+] Institute of Physics of the University, P.O. Box 304, Zagreb (Yugoslavia)
[++] Max-Planck-Institut für Medizinische Forschung, Heidelberg (F.R.G.)

We have measured the resistivity from 300 to 4.2 K and the magnetoresistance from 25 to 4.2 K in magnetic fields (H) up to 6 Tesla for three single crystals of $\beta(BEDT\text{-}TTF)_2I_3$ with current flow along the least conducting C* direction. There is an S shaped anomaly in $\rho_{C*}(T)$ starting near 180 K which we ascribe to the phase transition seen in X-ray studies [1,2]. From 9-100 K ρ_C* obeys an A + BT^2 low while below 9 K the three samples show broad superconducting transitions with $\rho(4.2)/\rho(9)$ values of 0.4, 0.11 and < 0.01. From the magnitude and angular dependence of the magnetoresistance above 9 K we conclude that the Fermi surface is just open in the a.b plane which is in contrast to other published work. From the measured angular dependence, and taking inter and intra stack molecular spacings of 6.2 and 4.1 Å, the ratio of transfer integrals in the a.b plane is $t_{\parallel}/t_{\perp} = 3.5_5 \pm 0.1_2$. We also find that Kohler's rule is obeyed from 9-25 K and using the same analysis [3] as for the Bechgaard salts, we obtain $t_{\perp}^{C*} \sim 2$ meV and a parallel mean free path of approximately 200 intermolecular distances at 9 K.

Below 8 K the angular dependence of $\rho_{C*}(H)$ is still well defined and the $\rho_{C*}(T)$ curves are independent of current density and thermal cycling to room temperature. Therefore the smeared superconducting transitions may perhaps represent some kind of "weak" superconductivity extending throughout the crystals rather than small regions of the high T_c phase as some authors have proposed.

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