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Electronic states of the dual-layered organic superconductor (BEDT-TTF)$_2$Ag(CF$_3$)$_4$(TCE)

Tadashi Kawamoto, Takehiko Mori[1], Shinya Uji[2], and John A. Schlueter[3]
[1]*Department of Organic and Polymeric Materials, Tokyo Institute of Technology, Japan*
[2] *National Institute for Materials Science, Japan*
[3]*Argonne National Laboratory, USA*

Email: kawamoto@o.cc.titech.ac.jp

(BEDT-TTF)$_2$Ag(CF$_3$)$_4$(TCE) has three polymorphs showing superconductivity, namely, the κ_{L}-, $\kappa\alpha'_1$- and $\kappa\alpha'_2$-phases [1-3]. Although the first phase is a typical κ-type compound, the last two phases have recently been identified as dual-layered superconductors composed of the κ- and α'-type donor layers. In the $\kappa\alpha'$-phases, the bond lengths of the donors indicate that the α'-layers are likely in charge ordered states. We investigate the superconducting properties and Fermi surface of the $\kappa\alpha'_1$-phase. The temperature dependence of the resistance is similar to the typical κ-type BEDT-TTF salts, and the superconducting transition temperature (midpoint T_c) is 9.5 K. The interlayer coherence length is sufficiently smaller than the thickness of the conducting layer, indicating a two-dimensional superconductor. The de Haas-van Alphen (dHvA) oscillation shows that the conducting layer is the κ-layer with a half-filled band; this is in agreement with the charge-ordered α'-layer due to the quarter-filled band. The effective cyclotron mass observed in the dHvA oscillation is larger than the bare cyclotron mass calculated. The BEDT-TTF superconductors including a κ-layer show the following trend: the higher the T_c of the material, the larger the mass enhancement

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