**Magnetism and ground state of an organic Mott insulator, $(BPDT\text{-}TTF)_2ICl_2$**

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The organic molecule, BPDT-TTF, is giving several charge-transfer complexes that have 2:1 composition with a monovalent anion and layered structure. In addition, because the BPDT-TTF has bulky propylene groups at the ends of the molecule, the BPDT-TTF salts have the tendency that the molecules have the dimer structure in the molecular layers. This situation is similar to that of κ- and β'-BEDT-TTF salts that provide Mott insulators and superconductors. In this regards, we investigated physical properties of one of the BPDT-TTF salts.

$(BPDT\text{-}TTF)_2ICl_2$ is known to be a semiconductor. Figure 1 displays a temperature dependence of the static magnetic susceptibility of $(BPDT\text{-}TTF)_2ICl_2$. We plotted the data of which core's contribution has been already subtracted. The relatively large value ($8\times10^{-4}$ emu/mole of f.u. at room temperature) as a organic conductor and a broad maximum at around 150 K were observed. These behaviors resemble those of a low-dimensional antiferromagnet, $\beta'\text{-}(BEDT\text{-}TTF)_2ICl_2$. However, while the $\beta'\text{-}(BEDT\text{-}TTF)_2ICl_2$ undergoes antiferromagnetic transition at 22 K, this salt shows other kinds of transition at 27 K. With the observation of no anisotropy below 27 K, we concluded that this transition is that to the spin-singlet state. To discuss the difference in the ground state between the two salts, we investigated the electronic anisotropy by resistivity measurements. We tabulated the room-temperature values of resistivity along the three crystallographic axes for the two salts in Table 1. The resistivity ratio of $(BPDT\text{-}TTF)_2ICl_2$ suggests strongly-enhanced one-dimensional nature of this salt. This electronic characteristic is considered to give rise to the different ground state from the BEDT-TTF salt.

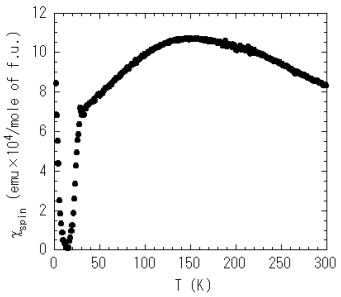


Fig. 1.
Temperature dependence of spin susceptibility of $(BPDT\text{-}TTF)_2ICl_2$ under a magnetic field of 1 T.

| | | Stacking direction | Side-by-side direction | Out-of-plane direction |
|---|---|---|---|---|
| $(BPDT\text{-}TTF)_2ICl_2$ | ρ (Ωcm) | 3.6 | 220 | 26000 |
| | ratio | 1 | 62 | 7200 |
| $\beta'\text{-}(BEDT\text{-}TTF)_2ICl_2$ | ρ (Ωcm) | 11 | 50 | 710 |
| | ratio | 1 | 4.5 | 65 |

Table 1. Room-temperatuture resistivities along the three axes for the two organic salts.