Electronic States of Organic Quasi-Two Dimensional Conductor β"-$(DODHT)_2PF_6$: Charge Ordering and Superconductivity

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We made x-ray satellite reflection measurements up to 0.7 GPa and transport measurements up to 1.9 GPa, specifically the angle-dependent magnetoresistance (AMR) ones at 1. 9GPa, of the title compound to investigate the following four problems; (1) how large the temperature-pressure regime is for the long-range charge ordering (CO), (2) whether or not the high pressure regime for the superconductivity is really a metallic state, (3) what the electronic properties are in the intermediate pressure regime between the long-range CO and the superconducting states, and (4) whether or not the charge degree of freedom plays some roles in the superconductivity. The present compound is suitable for studying CO because it is free from charge disproportionation due to site in-equivalence.

We found that the long-range CO is stable up to 0.7 GPa, and its temperature-pressure regime coincides with that expected from transport measurements. AMR at 1.9 GPa, 1.4 K and 12 T suggests the presence of Fermi surfaces consistent with band calculations based on x-ray structural analyses at room temperature and the same pressure. In the intermediate pressure where the resistance *vs* temperature curve shows a plateau in the intermediate temperature range, we found a decrease in sample's apparent dielectric constant with decreasing temperature, and some non-linearity in the current-voltage characteristics.

Raman studies by one of the author (KY) suggest the presence of metallic state in the intermediate pressure regime where the resistance shows apparently insulating properties. We will discuss the nature of the electronic state in this regime.

X-ray studies by one of the authors (RK) on β"-$(BEDT\text{-}TTF)_2CsCd(SCN)_4$, whose electronic structure is similar to that of the title compound at high pressure, for example 1.9 GPa or above, showed the presence of charge-density wave at ambient pressure below 32 K. This suggests that the spin degree of freedom plays a minor role in the superconductivity of the title compound. We will discuss possible mechanisms of the superconductivity of the title compound.

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