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Structural properties of the organic conductor $(DMEO\text{-}TTF)_2TaF_6$

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Introduction

The quasi-one-dimensional organic conductor $(DMEDO\text{-}TTF)_2PF_6$, where DMEDO-TTF stands for dimethyl(ethylenedioxy)tetrathiafulvalene, shows a structural phase transition in the range of 130-195 K, and the transition is a metal-metal (MM) phase transition [1]. The MM transition temperature increases with increasing the anion size in $(DMEDO\text{-}TTF)_2XF_6$ (X = P, As, and Sb). These conductors show metal-insulator (MI) transitions approximately at the same temperature of 50 K, and the insulating phase is nonmagnetic. However, the origin of the MI phase transition is not clarified, because of the crystal destruction in the MM transition.

The room-temperature structure of $(DMEDO\text{-}TTF)_2TaF_6$ salt is the same as the low-temperature structure of the PF_6 salt [2]. The TaF_6 salt also shows an MI transition at 50 K, and the ground state is a nonmagnetic insulator. The TaF_6 salt has no structural phase transition with the crystal destruction below room temperature. Therefore, the TaF_6 salt is a good material to investigate the MI transition in the series of $(DMEDO\text{-}TTF)_2XF_6$ conductors. The present paper reports structural properties of $(DMEDO\text{-}TTF)_2TaF_6$.

Results and Discussion

Figure 1 shows the synchrotron radiation x-ray oscillation photograph at 34 K. The photograph shows no superstructure with the intensity more than 1/500 times of the Bragg reflections. This result suggests that the MI transition is not a charge ordering. However, the possibility of the charge density wave state is not eliminated. The possible scenario is that the intensity of the superlattice reflection is less than 1/500 times of the original Bragg reflections. Figure 2 shows the temperature dependence of the lattice parameters. All lattice parameters smoothly decrease as the temperature decreases, and there is no anomaly at around the MI transition temperature (50 K). The present compound does not show a drastic structural change at T_{MI}.

In summary, we did not find any superlattice reflection with the intensity more than 1/500 times of the original Bragg reflections. The origin of the MI transition of the present compound is not clarified.

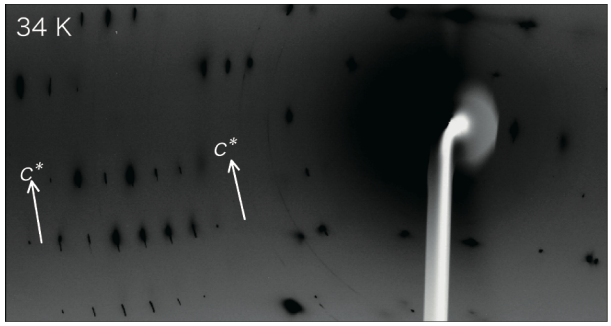

Figure 1: X-ray oscillation photograph at 34 K.

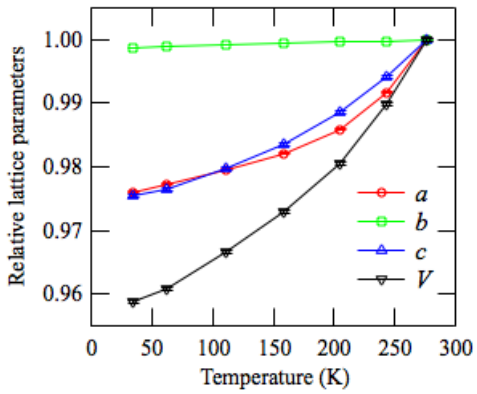

Figure 2: Temperature dependence of the lattice parameters of $(DMEDO\text{-}TTF)_2TaF_6$ normalized at room temperature.

References

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