Electrical Properties of New Organic Conductor $BEST_2MBr_4$ (BEST = (bis(ethylenediseleno) tetrathiafulvalene)); M= Fe, In) Under Very High Pressure

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Introduction

The Se atoms have lager diameter of electron clouds and expect to enhancement the π-*d* interactions. Here we synthesize new donor arrangement molecule organic conductors of $(BEST)_2MBr_4$ (M= Fe, In), both crystals show metallic behavior around room temperature. The electrical properties under high pressure are measured up to 10.8 GPa, and magnetic properties measurement are also performed. High pressure is useful to increase weak transverse transfer integrals, and to stabilize metallic states at lower temperature. In some cases, new properties can found, for example, the highest superconducting transition temperature (T_c=14.2 K at 8.2 GPa) in the organic conductor β'-$(ET)_2ICl_2$.[1]

Experimental

Samples were of a rectangular shape of (0.15 x 0.05 x 0.02 mm^3) and 5 μm gold wires were attached to the sample with gold paint and placed in the sample chamber of the diamond anvil cell (DAC). A mixture of fluorinert (3M) 1:1 of FC-70 and FC-72 was used for the pressure medium. The pressure was determined by the standard ruby fluorescence method at room temperature.

Results and Discussion

Coexistent of two different molecule donor arrangement columns of new organic conductor of $BEST_2MBr_4$(M= Fe, In) are synthesized. Electrical properties of $BEST_2InBr_4$ have been investigated under pressure up to 10.8 GPa. The room temperature resistivity decreases with pressurize up 8.6 GPa and increase at higher pressures. The temperature dependence shows complicated phase transitions including metal-semiconductor-metal- semiconductor transitions. The magnetic susceptibility of $FeBr_4$ salt shows an antiferromagnetic transition at 4.4 K. The magnetic transition curves are suppressed by magnetic field.

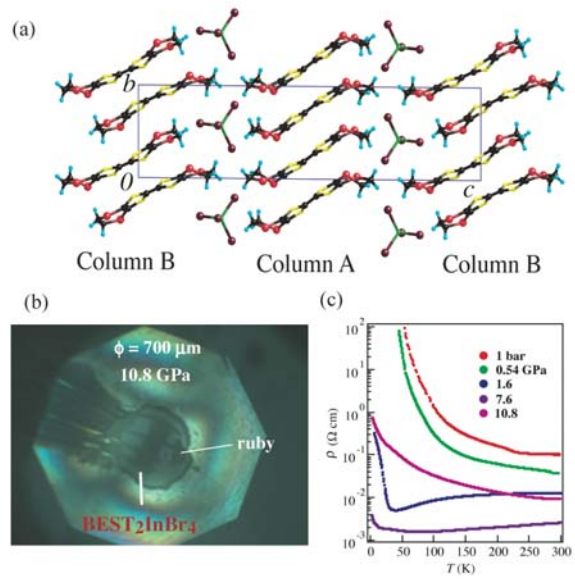

Fig. 1. (a) The crystal structure of $BEST_2MBr_4$ (b) The sample under 10.8 GPa, (c) The temperature dependent resistivity vs pressure.

Conclusions

We measured a new organic single crystal $BEST_2InBr_4$ under high pressure up to 10.8 GPa, using diamond anvil cell. We found this conductor shows complicated transitions with increasing pressure. The isostructural $FeBr_4$ salt also shows similar properties, and at low temperature it has an antiferromagnetic transition.

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References

[1] Taniguchi, H. *et al*., J. Phys. Soc. Jpn. **72**, 468-471(2003).