Magnetic-field-induced Superconductivity in Two Dimensional Organic Conductors

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BETS systems including Fe ions have attracted great interest because of intriguing phenomena arising from the interaction between the π conduction electrons on the BETS molecules and the localized Fe 3d moments. One of the most interesting features may be field induced superconductivity. For conventional superconductors, the superconductivity is destabilized under high magnetic fields. However, λ-$(BETS)_2FeCl_4$ shows superconductivity only under high magntic fields parallel to the conducting layers. In the phenomena, the π-d interaction plays an essential role. In λ-$(BETS)_2Fe_xGa_{1-x}Cl_4$, the superconducting (S) phase shifts to a lower field as x decreases whereas the anitiferromagnetic insulating phase (AFI) simply shrinks (Fig.1). The behavior is well understood by the reduction of the effective coupling between the π and Fe 3d moments[1,2]. In λ-$(BETS)_2FeCl_{4-x}Br_x$, however, the AFI phase expands with increasing x and the S phase remains in the high field region. For x=0.7, the AFI phase survives up to 28 T at 2 K, and the AFI and S phases seem to compete with each other at lower temperatures (Fig. 2). The S phase is most stabilized at 32 T as for x=0. The result suggests that the coupling between the π and Fe 3d moments does not change with x. However, the strong x dependence of the AFI phase suggests that the correlation between the π electrons is enhanced with x. We present the global phase diagram of the BETS systems and discuss the differences between them.

[1] S. Uji et al. Nature (London) **410**, 908 (2001), L. Balicas, et al. Phys. Rev. Lett. **87**, 067002 (2001),
[2] S. Uji et al. J. Phys. Soc. Japan **72**, 369 (2003).

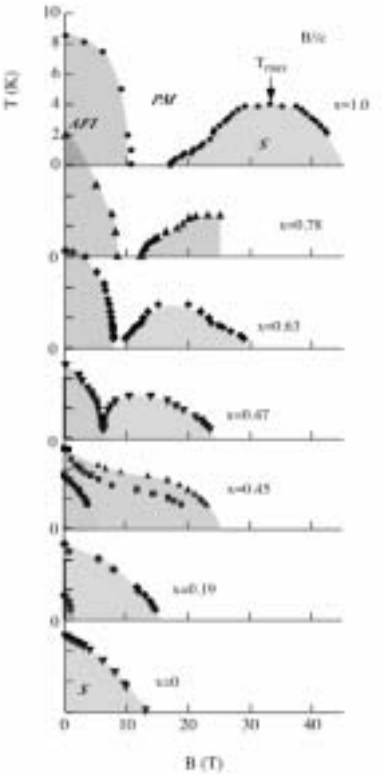

Fig.1 Phase diagram in λ-$(BETS)_2Fe_xGa_{1-x}Cl_4$,

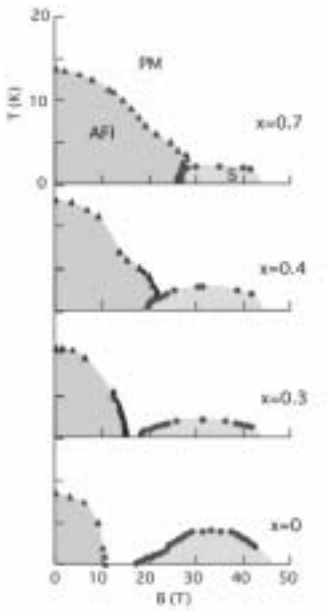

Fig.2 Phase diagram in λ-$(BETS)_2FeCl_{4-x}Br_x$