TOPICAL REVIEW

Experimental study of organic zero-gap conductor α-$(BEDT\text{-}TTF)_2I_3$

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Abstract. A zero-gap state with a Dirac cone type energy dispersion was discovered in the organic conductor α-$(BEDT\text{-}TTF)_2I_3$ under high hydrostatic pressures. This is the first two-dimensional (2D) zero-gap state discovered in bulk crystals with a layered structure. In contrast to the case of graphene, the Dirac cone in this system is highly anisotropic. The present system, therefore, provides a new type of massless Dirac fermion system with anisotropic Fermi velocity. This system exhibits remarkable transport phenomena characteristic to electrons on the Dirac cone type energy structure. The carrier density, written as $n \propto T^2$, is a characteristic feature of the 2D zero-gap structure. On the other hand, the resistivity per layer (sheet resistance R_S) is given as $R_S = h/e^2$ and is independent of temperature. The effect of a magnetic field on samples in the zero-gap system was examined. The difference between zero-gap conductors and conventional conductors is the appearance of a Landau level called the zero mode at the contact points when a magnetic field is applied normal to the conductive layer. Zero-mode Landau carriers give rise to strong negative out-of-plane magnetoresistance.

Keywords: organic massless Dirac Fermions system, transport phenomena, zero mode

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