Organic Mott-Transition FET

Mott-Transition Field Effect Transistor (MTFET) based on a \( \pi \)-electronic system was proposed by Newns et al in 1997 to overcome the low device mobility of organic FETs and scaling limitations of Si-FET. Organic charge transfer salts provide various Mott-type semiconductors whose insulating phase is directly connected to a superconducting phase in their phase diagrams. We have fabricated FET structure with a thin-layer single crystal of \( \kappa \)-(BEDT-TTF)\( \text{Cu}[\text{N(CN)}_2] \)Br laminated on a SiO\(_2\)/Si substrate in order to study if MTFET is possible with this material or not. At low temperatures, the device showed a clear \( n \)-type FET behavior as shown in Fig. 1. The device mobility of the best sample measured by four-probe method reached 94 cm\(^2\)/Vs. To understand the mechanism of this device, the Hall coefficient was measured and the carrier concentration was determined. Despite the \( n \)-type behavior of this device, the carrier under positive gate voltage was a hole and its number was almost 100% of the 1st Brillouin zone (Fig. 2). This abnormal Hall effect will be interpreted on the basis of MTFET.

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