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Pressure effect on organic field-effect transistors YUGO OKADA, KEN-ICHI SAKAI, SHIN KITAOKA, TAKAFUMI UEMURA, JUN TAKEYA, ISIR, Osaka University — Macroscopic transport in organic semiconductors is governed by intermolecular charge transfer, necessarily resulting in its sensitivity to molecular arrangement. The effect of external pressure in such soft materials is fundamentally important because of vulnerability in molecular displacement against relatively small force. Here, we introduce a method of measuring the effect of hydrostatic pressure on the conductivity in organic semiconductor crystals inducing high-mobility charge with the application of electric field. We performed four-terminal conductivity measurement to exclude extrinsic influence of the metal/semiconductor contact resistance. In addition, Hall coefficients are simultaneously measured to deduce the pressure coefficient properly. Using rubrene single-crystal transistors, variation of mobility under pressure turned out to be about 7 times larger than in the typical experiments reported for silicon and other inorganic semiconductors. Interestingly, the mobility starts to decrease with further increasing pressure above 600 MPa. The anomalous negative pressure effect indicate that the application of pressure not only diminishes distance between centers of adjacent molecules but relative positions of equivalent atoms in the two molecules.

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