Effect of structural deformation on charge transport in organic single-crystal semiconductors

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Small molecular organic semiconductor crystals form interesting electronic systems of periodically arranged "charge clouds" whose mutual electronic coupling determines whether or not electronic states can be coherent over molecular distances. Recently, it turned out that band transport is realized in high-mobility organic semiconductor crystals though this situation is not common to all organic semiconductors. This presentation first focuses on the single-crystal molecular assembly of pentacene which does not exhibit full charge coherence at room temperature under atmospheric pressure. Hall coefficient, telling us the extent of the electronic coherence, is precisely measured for accumulated charge in pentacene single-crystal field-effect transistors at various temperatures with varied pressure. With the application of external pressure, the electronic coupling between pentacene molecules is continuously modified so that the extent of the intermolecular coherence grows with increasing pressure.

In addition, it is demonstrated for newly synthesized decyl-dinaphthobenzodithiophene (C10-DNBDT)[1] that room-temperature mobility is increased by the factor of 1.7 with the application of uniaxial strain (Fig. 1) with restricted molecular vibration. The results indicate the significant impact of the structural modification to the charge transport properties in organic semiconductor devices.[2]

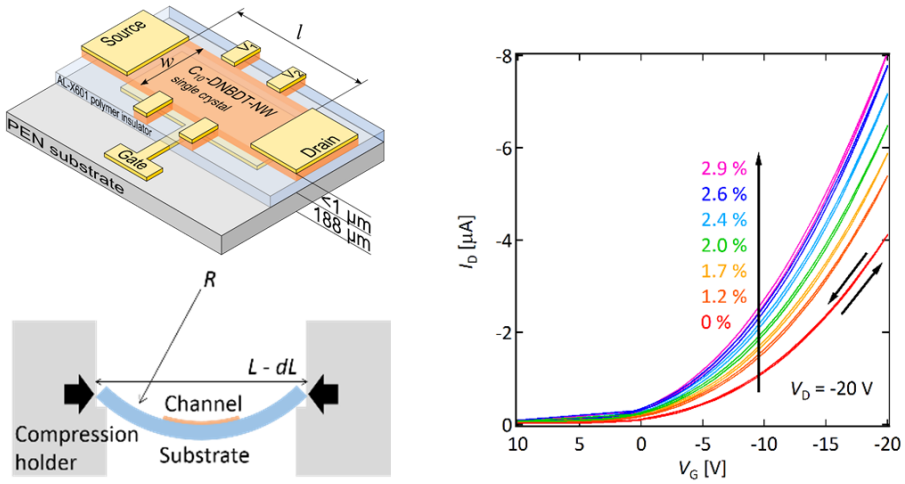

Fig. 1. A giant strain effect for C10-DNBDT single crystal transistors.

References

1. C. Mitsui, T. Okamoto, J. Takeya et al., *Adv. Mater.* 26, 4546 (2014).
2. K. Sakai, Y. Okada, S. Kitaoka, J. Tsurumi, Y. Ohishi, A. Fujiwara, K. Takimiya, and J. Takeya, *Phys. Rev. Lett.* 110, 096603 (2013).