Ambipolar transistor properties of segregated charge-transfer complexes
分離積層型電荷移動錯体のアンバイポーラトランジスタ特性

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Charge-transfer complexes are composed of charge-donating (D) and charge-accepting (A) molecules. While the parent compounds are unipolar semiconductors, charge-transfer complexes are expected to show ambipolar transistor properties. We have previously reported that mixed stacked complexes are semiconducting, but show field-effect transistor properties [1]. Even ionic charge-transfer complexes show transistor properties in the thin films [2]. However, in general, segregated complexes are too highly conducting to show transistor properties [3,4]. Here we report transistor properties of segregated 1,6-diaminopyrene (DAP) complexes of TCNQ [5] and dimethyl-TCNQ (DMTCNQ, Fig. 1). The segregated complex (Fig. 2) has a completely ionic ground state with the charge-transfer degree close to unity and thus behaves as a Mott-type insulator. Despite the high conductivity, after subtracting the bulk current of ~6 mA, the thin-film transistors show balanced ambipolar transistor properties (Fig. 3), which are maintained down to 200 K (Fig 4). The newly prepared DMTCNQ complex exhibits similar ambipolar transistor properties (Fig. 5).

[1] R. Sato, *et al*, *J. Mater. Chem. C*, 2019, **7**, 567. [2] Uekusa *et al*, *ACS Applied Mater. Interf*. 2020, **12**, 24174. [3] M. Sakai, *et al*, *Phys. Rev. B* 2007, **76**, 045111. [4] Y. Kawasugi, *et al*, *Appl. Phys. Lett*. 2008, **92**, 243508. [5] T. Inabe, *et al*, *Acta Chim. Hung*. 1993, **130**, 537.

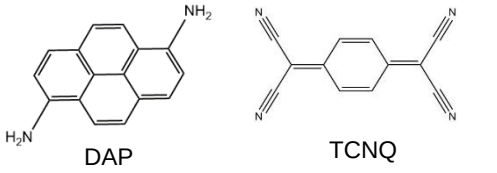

Fig. 1. Donor and acceptor molecules

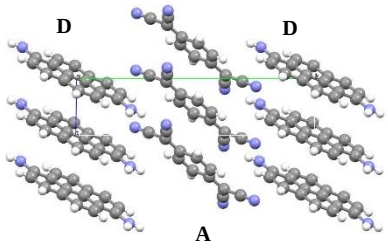

Fig. 2. Crystal structure of DAP-TCNQ [5].

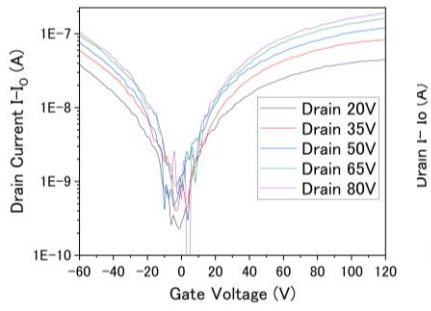

Fig. 3. Transfer characteristics of a DAP-TCNQ transistor.

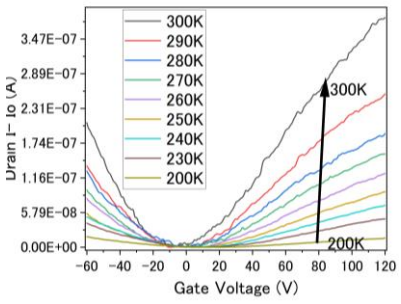

Fig. 4. Temperature dependence of the transfer characteristics of a DAP- TCNQ transistor.

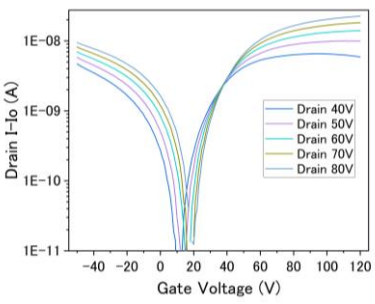

Fig. 5. Transfer characteristics of a DAP-DMTCNQ transistor.