Development of β-linked Quaterthiophene and Tetrathiafulvalene Dimers as New Organic Semiconductors

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High performance organic semiconductors have been widely developed in recent years because of their industrial use for flexible, low-cost, and large-area coverage electronic devices. As for twisted-form molecules, solution processable organic field-effect transistors (OFETs) utilizing swivel cruciform oligothiophenes have been reported [1]. To tune molecular packing motif and environmental stability, we focus on twisted molecular geometry of β-linked quaterthiophene dimers, which are thought to be less conjugated π-system than linear octithiophenes indicative of stable lowered HOMO level under environmental condition, and are expected to maintain side-by-side intermolecular interactions through sulfur-sulfur short contacts. As an active component of OFETs or molecular conductors, we present here the synthesis and properties of new β-linked quaterthiophene dimers of 1 and 2, where the central bithiophene unit is linked at β-position of thiophene ring, and tetrathiafulvalene (TTF) dimer of 3, where TTF is linked with ethyne spacer for the planarity to make conduction path (Fig. 1). As expected, redox and optical properties of 1 and 2 are similar to that of the parent α-α′-butylquaterthiophene. This demonstrates that two quaterthiophene units of 1 and 2 have no electronic interaction. Compound 3 shows similar trend. Both 1 and 2 are moderately soluble in common organic solvents. The crystal structure and FET fabrication of the present compounds are also investigated.