Imide-Functionalized Polymeric Semiconductors for High-Performance Organic Thin-Film Transistors

Xugang Guo

Department of Materials Science and Engineering, South University of Science and Technology of China, No. 1088, Tangchang Blvd, Shenzhen, China 518055
Tel: 86-755-88018307, E-mail: guo.xg@sustc.edu.cn

Imide-functionalized arenes have been widely used as small-molecule n-type organic semiconductors for applications in organic thin-film transistors. Recently, they have shown great potentials for constructing high-performance polymer semiconductors [1,2] for effective tuning the bandgaps and frontier molecular orbitals (HOMOs and LUMOs) as well as film microstructures and morphologies of resulting polymers.

Here, we present the imide-functionalized polymer semiconductors for applications in high-performance organic thin-film transistors (OTFTs). The imide-functionalized arenes are naphthalene diimides, phthalimides, thiophene imides (also known as thieno[3,4-c]pyrrole-4,6-diones), and bithiophene imides. By copolymerizing with different electron donor co-units, we are able to achieve the polymer semiconductors having varied charge carrier polarities (n-type, p-type, and ambipolar), substantial carrier mobility, and good device air-stabilities. The n-type polymer have electron-mobilities greater than 0.1 cm^2/Vs [3], and p-type polymer semiconductors show hole mobilities approaching 0.6 cm^2/V [4], the inkjet-patterned polymeric CMOS inverters show voltage gains as high as 40 [3]. More promising is that the p-type polymer semiconductors achieve enhanced device stability (environmental and operational) [5]. The device performance of these semiconducting polymers is well correlated with their electronic structures and film microstructures [6].

References

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