Synthesis and Molecular Properties of New Alkylated Ladder-Type Structures and Their Applications in Organic Photovoltaics

Yen-Ju Cheng

Department of Applied Chemistry, National Chiao Tung University, 1001 Ta Hsueh Road, Hsin-Chu, 30010, Taiwan

E-Mail: yjcheng@mail.nctu.edu.tw

Forced planarization by covalently fastening adjacent aromatic units in the polymer backbone strengthens the parallel p-orbital interactions to elongate effective conjugation length and facilitate electron delocalization, providing an effective way to reduce the band gap and enhances the intrinsic charge mobility. It is envisaged that the well-defined ladder-type small molecules can function as donor monomers to polymerize with acceptor units, leading to a new class of donor-acceptor semi-ladder copolymers that can be suitably used for solution-processable polymer solar cells. Therefore, elegant designs and synthesis have been devoted towards hybridizing electron-rich aromatic subunits into mutually fused structures in the anticipation of extracting their individual intrinsic advantages. Various accessible electron-rich aromatic and heterocycles building blocks such as benzene, thiophene, selenophene, pyrrole, silole, germole, cyclopentadiene moieties can be chemically assembled to afford a range of fascinating ladder-type conjugated skeletons with tunable properties and functions. It should be emphasized that incorporation of aliphatic side chains into the conjugated backbone is necessary and side-chain engineering plays a critical role for such ladder-type conjugated molecules. A series of donor-acceptor conjugated copolymers have been designed and synthesized. The applications of these polymers in bulk-heterojunction solar cells will be discussed. [1-4]

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