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Ionic polymerization using flow microreactor systems and its applications to syntheses of structurally well-defined polymers

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Polymerization using the characteristic features of flow microreactor systems such as fast mixing, fast heat transfer, and short residence time has attracted a great deal of attention, and extensive studies have been reported. In this presentation, we report that the cationic polymerization of vinyl monomers can be achieved in a flow microreactor system with excellent molecular-weight distribution control without adding a capping agent, which decelerates the propagation due to the equilibrium between active and dormant species. We also report that flow microreactor systems are effective for accomplishing the controlled anionic polymerization of styrenes or alkyl methacrylates or alkyl acrylates. A high level of control of the molecular weight distribution can be achieved in a flow microreactor under easily accessible conditions. Moreover, the efficient synthesis of well-defined polymers was successfully achieved using an integrated flow microreactor system. Diblock copolymers and triblock copolymers were obtained with narrow molecular weight distributions.

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High-efficiency non-fullerene organic solar cells with perylene-diimide as acceptor material

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A non-fullerene solar cell (NF-SC) employs n-type organic semiconductor (small molecule or polymeric) as the non-fullerene acceptor (A), which is used to replace the fullerene one in organic solar cells. The non-fullerene acceptor is normally blended with polymer or small molecule donor (D), forming so-called bulk-heterojunction (BHJ) structure. The resulted BHJ blend acts as the photoactive layer to harvest the solar energy. In recent two years, the power conversion efficiency (PCE) of a state-of-the-art NF-SC has been fast raised, going from 4% to over 8%. The achievement of a PCE value up than 6% means that the NF-SC is potential to compete with the fullerene based counterparts. We have synthesized a series of perylene diimide acceptors with twisted conformations. The twisted conformation reduces the aggregation tendency, leading to formation of nanoscale aggregates when blended with an electron-donor material, which is expected to promote the charge dissociation that takes place at the donor-acceptor interfaces. We have achieved a power conversion efficiency of 4.03% in 2013 with the thienyl-bridged perylene diimide dimer as the non-fullerene acceptor. We then applied this concept to design and synthesize naphthalene diimide derivatives. In this talk, I will show the attendees these advances.

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