Versatile synthetic routes for conjugated rod-coil block copolymers and their use in solar cell devices

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Conjugated polymers are promising materials for the development of low cost optoelectronic devices. The processabilty of these polymers and the control of their bulk and thin film morphology are of outmost importance for the low cost efficient photoactive materials. The design of polymer materials for solution-processed photoactive materials for photovoltaic devices has been extensively studied during the recent past. Relatively high energy conversion efficiencies (up to 5.2%) were achieved by using blends of poly-(3-alkyl)thiophenes (P3ATs) with fullerene derivatives as photoactive layer where electron-donating polymers (ex. P3ATs) and electron-accepting fullerenes form a donor-acceptor bulk heterojunction (BHJ) interpenetrated network. Solar Cell device performances and stability strongly depends on the active layer morphology which can be dramatically affected by the process (spin coating, annealing temperature..) and the molecular architecture of the macromolecules.

Conjugated rod-coil block copolymers are suitable materials for organic optoelectronic applications and in particular for solar cells. They can be designed so as to be soluble in organic solvents and allow control of stable nanometer size structures as a consequence of their equilibrium mesomorphic phase separation. Furthermore block copolymers can be used as surfactants in polymer blends reducing the interfacial tension and thus stabilising thermodynamically the phase separated structures.

Rod-coil block copolymers can be obtained from conjugated macro-initiators: poly(para phenylene vinylene) (PPV), Polythiophene, Polyfluorene, Poly(thienylene vinylene) or oligomers, mainly by controlled/living radical polymerization. These synthetic techniques allow the polymerization of functional monomers for the coil block which is suitable to tune the materials properties. They can also obtained by anionic polymerization of the coil block and reaction of the living chains on a functionalized conjugated rod block in order to obtain a well defined copolymer architectures.

Our presentation will be an overview of our recent results concerning the versatile synthetic routes of conjugated rod-coil block copolymers and their use as active materials on photovoltaic devices in their pure form and as surfactants in electron donor-acceptor polymer blends.

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