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New Materials and Approaches for Solution-Processed Organic Solar Cells

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Organic solar cells have been proposed as low-cost and sustainable alternatives for power generation. To realize the low cost aspects of organic solar cells, conventional vacuum deposition technologies are to be replaced with solution processing. Our group has focused on the development of solution processable conductive polymers. Conductive polymers, like polyaniline, are generally doped with small-molecule acids. Though highly conductive, such materials are not processable. To overcome this intractability, polymer-acid dopants have replaced small-molecule acids. While the introduction of polymer acids render the conductive polymer solution processable, such gains in processability are accompanied by reduced conductivities. With a post-processing solvent-annealing treatment, however, we have been able to dramatically improve the electrical properties of polymer-acid doped conductive polymers; these polymers make efficient anodes in organic solar cells. To further improve the efficiencies of organic solar cells, we have introduced fractional amounts of additives within the active layer of the device. Depending on the hydrophobicity of the additives, they preferentially segregate into the electron donor phase, effectively enhancing phase separation between the electron donor and electron acceptor. This change in morphology increases charge separation; we see a two-fold increase in the short-circuit current in such devices over those without additives in the active layer.