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The Consequence of Donor-acceptor Miscibility on Charge Transport and Photovoltaic Device Performance KIARASH VAKHSHOURI, DEREK KOZUB, Chemical Engineering, The Pennsylvania State University, CHENCHEN WANG, ALBERTO SALLES, Materials Science and Engineering, Stanford University, ENRIQUE GOMEZ, Chemical Engineering, The Pennsylvania State University — Recent energy-filtered transmission electron microscopy studies revealed that amorphous mixed phases are ubiquitous within mesostructured polythiophene/fullerene mixtures. The role of mixing within nanophases on charge transport of organic semiconductor mixtures, however, is not fully understood. Through the combination of Flory-Huggins theory and energy-filtered transmission electron microscopy, we have estimated the miscibility limit of polythiophene/fullerene blends. We have also demonstrated the interplay between miscibility and percolation to describe field-effect mobilities as a measure of the conductive pathways present in a model organic semiconductor mixture (amorphous polythiophene/fullerene blends). Our studies reveal that the miscibility of the components strongly affects electron transport within amorphous blends. Immiscibility promotes efficient electron transport by promoting percolating pathways within organic semiconductor mixtures. However, strongly immiscible systems would readily phase separate into large domains, preventing efficient charge separation in organic photovoltaics. Consequently, an optimum degree of miscibility between donor/acceptor mixtures exists for the application of such mixtures to organic solar cells.

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