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On the Origins of Reduced Nongeminate Recombination in Organic Semiconductor Blends MICHAEL HEIBER, Institute of Physics, Chemnitz University of Technology and Experimental Physics VI, Julius-Maximilians-University of Würzburg, VLADIMIR DYAKONOV, Experimental Physics VI, Julius-Maximilians-University of Würzburg and Bavarian Centre for Applied Energy Research (ZAE Bayern), CARSTEN DEIBEL, Institute of Physics, Chemnitz University of Technology — Despite vast research on organic semiconducting materials and devices over the last two decades, significant gaps in fundamental understanding exist in key areas. A detailed understanding of charge carrier recombination is particularly important to promote efficient radiative recombination in light emitting diodes, minimize power conversion efficiency losses in photovoltaics, and enhance sensitivity in photodiodes. Bimolecular charge recombination in these devices is commonly described using the Langevin model, which assumes an encounter-limited process. However, blends for organic photovoltaics have often been measured to have major deviations from the Langevin model, most significantly a recombination rate that is several orders of magnitude less than expected. Here, transient experimental and computational simulation results are presented to help elucidate the origins of the unexpected nongeminate recombination dynamics, focusing on the role of morphology, charge carrier mobility, density of states, and charge-transfer state properties. We demonstrate that greatly reduced recombination rates are not an inherent property of phase separated systems and show how charge-transfer state properties can have a critical impact on the recombination dynamics.

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