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Insights from transport modeling of unusual charge carrier behavior of PDTSiTzTz:$PC_{71}BM$ bulk heterojunction materials[1] OLEKSIY SLOBODYAN, SARAH MOENCH, KELLY LIANG, ERIC DANIELSON, BRADLEY HOLLIDAY, ANANTH DODABALAPUR, Univ of Texas, Austin — Development of hole-transporting copolymers for use in bulk heterojunctions (BHJs) has significantly improved organic solar cell performance. Despite advances on the materials side, the physics of charge carrier transport remains unsettled. Intrigued by its ability to maintain high fill factors in thick active layers, we studied the copolymer poly[2-(5-(4,4-dioctyl-4H-silolo[3,2-b:4,5-b']dithiophen-2-yl)-3-tetradecylthiophen-2-yl)- 5-(3-tetradecylthiophen-2-yl)thiazolo[5,4-d]thiazole] (PDTSiTzTz) blended with $PC_{71}BM$. Results show mobilities which are carrier-concentration-dependent and characterized by a negative Poole-Frenkel effect. Such behavior is not described by current carrier transport models. Established transport mechanisms like multiple-trap-and-release or variable range hopping yield dependence of mobility on carrier concentration. However, a more basic model like Gaussian distribution model (GDM) is needed to produce the negative Poole-Frenkel effect, though GDM cannot describe carrier-concentration-dependent mobility. We have combined key aspects of existing models to create a unified transport model capable of describing phenomena observed in PDTSiTzTz:$PC_{71}BM$. This model can be used to address open questions about transport physics of organic BHJ materials.

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Oleksiy Slobodyan
Univ of Texas, Austin

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