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Modeling space-charge-limited current transport in spatially disordered organic semiconductors[1] M. ZUBAIR, Y.S. ANG, L.K. ANG, Singapore University of Technology and Design — Charge transport properties in organic semiconductors are determined by two kinds of microscopic disorder, namely energetic disorder and the spatial disorder. It is demonstrated that the thickness dependence of space-charge limited current (SCLC) can be related to spatial disorder within the framework of fractional-dimensional space. We present a modified Mott-Gurney (MG) law in different regimes to model the varying thickness dependence in such spatially disordered materials. We analyze multiple experimental results from literature where thickness dependence of SCLC shows that the classical MG law might lead to less accurate extraction of mobility parameter, whereas the modified MG law would be a better choice in such devices. Experimental SCLC measurement in a PPV-based structure was previously modeled using a carrier-density dependent model[2] which contradicts with a recent experiment[3] that confirms a carrier-density independent mobility originating from the disordered morphology of the polymer. Here, this is reconciled by the modified MG law which intrinsically takes into account the effect of spatial disorder without the need of using a carrier-density dependent model.

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[2]Appl. Phys. Lett. 86, 092105 (2005)
[3]Adv. Funct. Mater. 26, 21 (2016)

Muhammad Zubair
Singapore University of Technology and Design

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