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Modeling organic light emitting diodes: A comparison between the conventional and a new carrier recombination models

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Abstract
Charge carrier recombination is a fundamental process in the operation of light emitting diodes (LEDs). Radiative carrier recombination produces light, which is the desired output for LEDs, and hence should be maximized, whereas the other carrier recombination processes should be minimized. A new model for quantifying the net carrier recombination rate in semiconductor devices (including LEDs) has been proposed recently, asserting that the new model gives a more realistic description of the carrier recombination processes in semiconductor devices than the conventional carrier recombination model. In this paper, we compare between the use of the new and the conventional carrier recombination models in modeling organic LEDs (OLEDs), particularly in predicting and analyzing the current-voltage (J-V) characteristics of OLEDs. It is shown that the J-V characteristics of OLEDs obtained using the new recombination model differ significantly compared with the J-V characteristics obtained using the conventional recombination model. Therefore, further studies are urgently needed to decisively determine which one of the two models is the more accurate model for describing the net carrier recombination rate in OLEDs (or in semiconductor devices in general) so that the more accurate model can be used when analyzing and predicting the performance of OLEDs. © 2023 Author(s).

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