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A physics-based current–voltage model for organic solar cells using a combined analytical and regression approach

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Abstract

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Abstract

A model that can accurately describe the current – voltage (J–V) characteristics of organic solar cells (OSCs) is crucial for understanding the operation and improving the performance of OSCs. J–V models based on analytical methods lack the accuracy due to their inability to consider realistic charge carrier generation and recombination. In this paper, we propose a model for describing and

predicting the J–V characteristics of OSCs using a combination of analytical and regression methods. The proposed model allows us to consider the effects of realistic carrier recombination and generation in obtaining the J–V characteristics. We verify that the proposed model works very well and demonstrate its usefulness by analyzing the effect of trap-assisted recombination on the J–V characteristics of OSCs, which cannot be analyzed using existing analytical-based J–V models. We also show that the proposed J–V model is considerably more reliable than J–V models based on established numerical methods such as finite difference methods. Since the proposed J–V model is significantly more accurate than analytical-based J–V models and considerably more reliable than numerical-based J–V models, the proposed J–V model can be a valuable tool for predicting, analyzing, and improving the performance of OSCs. © 2023, The Author(s), under exclusive licence to Springer-Verlag GmbH, DE part of Springer Nature.

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Charge carrier generation; Charge carrier recombination; Current – voltage characteristics; Photovoltaic cells ; Power conversion efficiency

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