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Probing the Thickness Limits of Organic Solar Cells using Monte Carlo Simulation[1] MIKE HEIBER, ALI DHINOJWALA, The University of Akron — Organic solar cell performance has increased dramatically in recent years, but in order to achieve higher efficiency devices, it is imperative to understand the remaining fundamental challenges. One major shortcoming is that thin film devices cannot absorb all of the targeted incoming light due to the limited optical density of the materials used. To overcome this, thicker devices that can maintain the high quantum efficiency and high fill factor, present in thin state-of-the-art devices, must be developed. We have taken advantage of recent advancements in dynamic Monte Carlo (DMC) simulation methods to study the current-voltage (J-V) behavior of organic solar cells with different thicknesses. This method allows all detailed physical mechanisms of the device to be simulated and as a result, the effects of device morphology and a range of material properties can be captured. Studying device behavior as a function of thickness highlights the importance of the competition between light absorption and charge recombination. The effects of carrier mobility and active layer morphology are also considered. Understanding this tradeoff between absorption and recombination will help direct future experimental efforts to design optimal materials and devices.

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