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Modeling organic bulk-heterojunction solar cells: Parameter stability and photocurrent transients ROGER HAUSERMANN, ETH Zurich, Switzerland, EVELYNE KNAPP, MICHAEL MOOS, NILS REINKE, ZHAW Winterthur, Switzerland, THOMAS FLATZ, Fluxim AG, Switzerland, BEAT RUHSTALLER, ZHAW Winterthur and Fluxim, Switzerland — An opto-electronic device model for organic bulk-heterojunction solar cells is presented (setfos by fluxim). First, the optical in-coupling into a multilayer stack is calculated. From the photon absorption profile a charge-transfer (CT) exciton profile is derived. These CT-excitons are then dissociated according to the Onsager-Braun model. The resulting motion of electrons and holes is modeled considering both drift and diffusion. We analyze measurements on P3HT:PCBM based solar cells and derive a set of parameter values, including values for CT-exciton dissociation. The experiments are well described and the stability of the parameters under various conditions is tested. This includes the simulation of current-voltage curves, the dependence of the short-circuit current on the layer thickness, and transient photo-currents. It is shown that simulating the transient photo-current is particularly helpful in determining the values of electron and hole mobility. This highlights the need to measure transient photocurrents to extract device parameters such as mobilities and CT-exciton dissociation constants.

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Roger Hausermann
ETH Zurich

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