Abstract Submitted
for the MAR14 Meeting of
The American Physical Society

Interpreting impedance spectra of organic photovoltaic cells - Extracting charge transit and recombination rate constants TYLER MULLENBACH, YUNLONG ZOU, RUSSELL HOLMES, University of Minnesota — Impedance spectroscopy has been widely used to extract the electron-hole recombination rate constant in organic photovoltaic cells (OPVs). This technique is typically performed on OPVs held at open-circuit. Under these conditions, the analysis is simplified with recombination as the only pathway for the decay of excess charge carriers; transit provides no net change in charge density. In this work we generalize the application and interpretation of impedance spectroscopy for bulk heterojunction OPVs at any operating voltage. This, in conjunction with reverse bias external quantum efficiency measurements, permits the extraction of both recombination and transit rate constants, offering a more complete picture of charge carrier dynamics in the device. Using this approach, both rate constants are determined for OPVs with varying electron donor-acceptor pairings and compositions. It is found that neither rate constant individually is sufficient to characterize the efficiency of charge collection in an OPV. A large recombination rate constant is not, on its own, detrimental if it coincides with a large transit rate constant. The technique presented here permits a detailed understanding of how OPV architecture and processing conditions impact the transient behavior of charge carriers, elucidating the origin of optimum device configurations.

Tyler Mullenbach
University of Minnesota

Date submitted: 15 Nov 2013 Electronic form version 1.4