# THE ROLE OF CONTACT SELECTIVITY IN SEMITRANSPARENT ORGANIC PHOTOVOLTAICS

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**Abstract**

Organic Photovoltaics (OPV) have been studied for nearly 30 years and the technology is now on the verge of commercialization. With record power conversion efficiencies approaching 10 % in small laboratory devices efficiency of OPVs still lag behind other technologies such as Silicon-based photovoltaics that can provide 15 % in module. However, the benefits of OPV rely on the possibility to produce flexible and low weight products with a high degree of design freedom. In addition, it has been claimed that OPV can overperform silicon technology under low light conditions. However; this statement has not yet been proved as a general principle. These advantages and the ease of handling in subsequent product-integration processes will enable the development of consumer and portable electronics and building-integrated photovoltaic (BIPV) products.It is known, that bulk heterojunction morphology in polymer-fullerene solar cells is a significant condition for the efficient photogenerated exciton separation, however with a random distribution of donor and acceptor in the active layer charge carriers can be trapped causing efficiency decreasing. One of the solutions is the controlled vertical phase-segregation, where electron selective fullerene is predominantly covering the cathode in a consequence of determined device treatment. Different techniques, such as: X-ray diffraction, variable-angle spectroscopic ellipsometry, transmission electron microscopy etc. have been developed to study segregation of donor and acceptor materials within the active layer. However the abovementioned techniques are complementary and each presents its own limitations that make them inaccessible to many research labs.Here we present a direct method based on EQE measurements to observe the donor/acceptor concentration at a given interface by measuring its individual contribution towards the photocurrent. The technique relies on the differential penetration of the light depending on the wavelength. Importantly, we are able to discern the cases in which having a high concentration of donor or acceptor at the incorrect contact (selective to the opposite carrier) have an impact on the device performance. Moreover, using impedance spectroscopy, we explained the importance of vertical segregation in the bulk-heterojunction organic solar cells at low light intensities, which his particularly important for the indoor applications.

**Keywords:** Organic photovoltaics, semitransparent solar cells, vertical segregation, quantum efficiency, impedance spectroscopy

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