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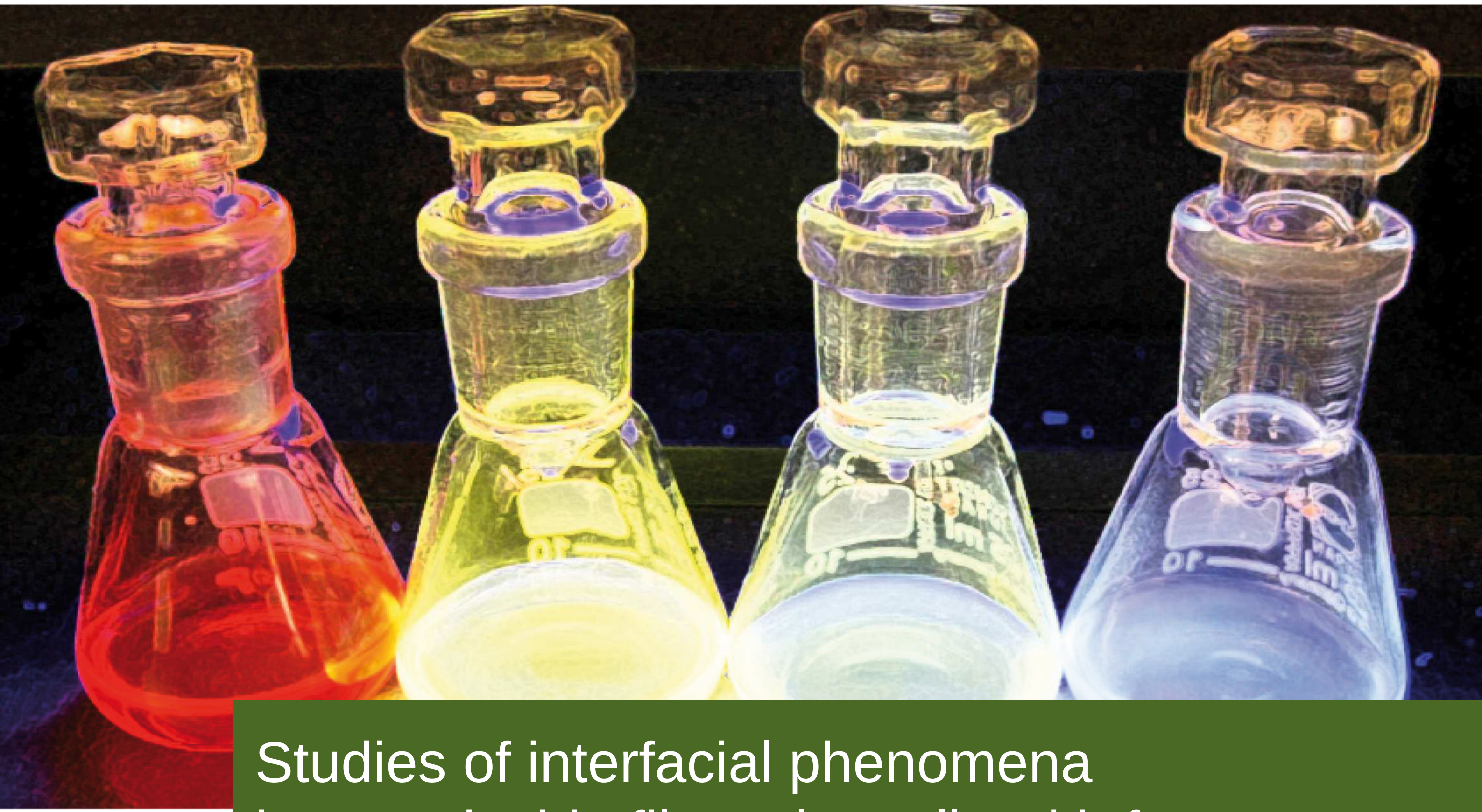

Studies of interfacial phenomena in organic thin film solar cells with frequency resolved opto-electronic techniques

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The power conversion efficiency of polymer solar cells has increased over the last years and record efficiencies for single junction cells are approaching 10%. The rapid increase in performance is largely due to the development of novel donor materials which incorporate a donor-acceptor structure leading to broader optical absorption. Stability remains the most critical issue for advances in polymer photovoltaics. Realizing high performance, stable organic photovoltaics requires an in depth understanding of not just the properties of the active layer, but also of transport layers and material interfaces. It is generally challenging to differentiate between loss mechanisms originating in the active layer or at contact materials in fully operational devices. Frequency resolved (opto)-electronic techniques such as impedance spectroscopy (IS) and intensity modulated photocurrent spectroscopy (IMPS) are powerful for gaining insight carrier transport, trapping and recombination phenomena in complex solar cell architectures.

In this study, we applied IS and IMPS to study state of the art polymer:fullerene solar cells based on the low band gap polymer PTB7 and the fullerene derivative PC70BM. Exposing the devices to ambient conditions for 4 weeks does not lead to a loss in power conversion efficiency. With IS and IMPS we demonstrate that the contact materials are stable. Loss in solar cell performance can be correlated with trap formation in the organic active layer. These results demonstrate the potential for realizing high efficiency, stable polymer:fullerene solar cells.