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Controlling the electronic interface properties in polymer-fullerene bulk-heterojunction solar cells

The main goal is to gain better understanding on how doping interfacial electrode layers influences the electronic properties of the (i) buffer layer / semiconductor layer interface as well as the (ii) buffer layer / (metal) electrode interface in organic solar cells. More precisely, we are interested in gaining better insight into the origin of interface failure mechanisms, like the appearance of a second diode or surface recombination. To analyze these loss mechanisms, solution processable zinc oxide (ZnO) precursors with various doping concentration and work function are being developed as interfacial layers. These investigations are relevant to correlate the bulk electronic properties of the interfacial layer to the performance of an organic solar cell. In a second step (i.e. in the second period) we plan to investigate the impact of the surface properties of the interface layer on the device performance. Doped metal oxide interface layers will be decorated with conjugated polyelectrolytes (CPEs), ligands or self-assembled monolayers (SAMs). Surface sensitive and electrical measurement techniques will be applied to characterize the surface modifications and the interface layer functionality will be verified at the hand of solar cell studies and simulations. Understanding the interface failure mechanisms will allow to derive design rules for interface materials and surface modifications and to build more environmentally stable solar cells.