Interfaces in organic and hybrid optoelectronics:

Organic/hybrid optoelectronic devices have drawn the attention of both the academic and industrial research communities due to the potential for a low-cost, large area, solution processible technology alternative to conventional inorganic optoelectronics. The function and performance of these devices is tightly related to their nanostructure and the electronic structure of the surfaces and hetero-interfaces of the device components. Many organic/organic and organic/TiO_2 interfaces have been extensively investigated, and efficient optoelectronic devices – such as polymer:fullerene and Grätzel solar cells – have been successfully demonstrated. We focus on the study of the vast array of interfaces that are far less investigated. For example, we found that a remarkable 50% of photoexcitations result in bound charge pair (BCP) states at the polymer/ZnO interface, never directly observed previously. We also showed that a self-assembled monolayer modification of the interface halves the amount of BCPs resulting in a three-fold increase in the photovoltaic performance. Through our work, we have demonstrated that once the interfacial structure is resolved and the physio-chemical processes are well understood, it is possible to tame even disordered interfaces to be utilized in a broad range of optoelectronic applications.

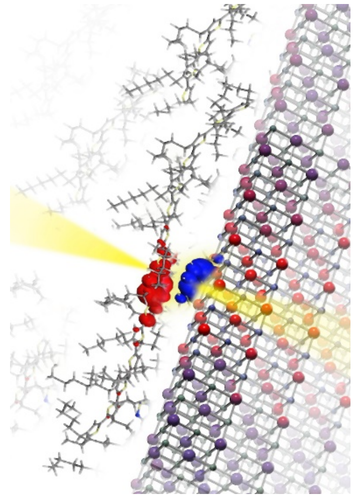

Illustration of exciton charge separation across a hybrid interface in an organic-inorganic photovoltaic device