Nanostructured hybrid ZnO thin films for energy conversion

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A new class of hybrid material consisting of a mixture of inorganic and organic components is currently leading the way in the search for new multifunctional materials. Such materials are well suited for use in low cost devices for photovoltaic conversion of sunlight. In this context, ZnO is an abundant and cheap material that can be easily synthesized and tailored for hosting several types of organic dyes.

In this work we report on hybrid films based on ZnO/organic dyes prepared by electrodeposition using Tetrasulphonated Copper Phthalocyanines (TS-CuPc) and Eosin-Y (EOY). Both the morphology and porosity of hybrid ZnO films are highly dependent on the type of dyes used in the synthesis. Different morphologies were obtained using TS-CuPc and Eosin-Y in aqueous media. These morphologies, as well as the porosities of the hybrid films, were characterized using SEM, TEM and AFM techniques. Photoelectrochemical methods were used to assess the photosensitivity of the ZnO/dye hybrid films, revealing a high photosensitivity for ZnO/Eosin-Y films and a very weak photoresponse for ZnO/TS-CuPc films.

This study asserts that even if the absorption coefficient of TS-CuPc is much higher than that of Eosin-Y, the energy levels of TS-CuPc do not correlate well with that of ZnO and thus photoelectrons cannot reach the conduction band of ZnO. On the contrary however, in ZnO/Eosin-Y hybrid films, the excited photoelectrons between the Eosin-Y levels can be extracted through ZnO, with the porosity of ZnO/Eosin-Y also easily controlled.