Oxide – organic heterostructures: non-destructing charge displacement recognition in SnO_x / CuPc buried interfaces

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Low-dimensional hybrid nanoscale materials are under rapid development due to number of technological applications [1]. Especially, inorganic – organic heterojunctions are attracting more and more attention because of their vast range of applications ranging from photovoltaics through other optoelectronic and thermoelectronic devices to inorganic-organic transistors [2,3,4].

Reduced tin dioxide / copper phthalocyanine (SnO_x/CuPc) heterojunctions recently gained much attention due to their defect structure allowing to tune the electronic properties at the interface towards particular applications. Therefore we focus on the creation and recognition of the interface between the oxide and organic layers exploiting surface sensitive photoelectron spectroscopy techniques. Particularly, angle dependent X-ray and UV photoelectron spectroscopies (ADXPS and UPS, respectively) with augmentation of energy-resolved photoemission yield spectroscopy (PYS) were utilized for non-destructive analysis of the chemical and electronic properties at the SnO_x/CuPc interface. The studies have been supported with computer simulations on charge transfer between interface constituents. Thanks to the dual approach, i.e. angle- and energy-resolved measurements, we could determine the role of oxides defect states role as well as the carbon contamination impact on the creation of the SnO_x/CuPc interface.

The combination of ADXPS and PYS allowed determination of the work functions and ionization energies of the constituent layers. Moreover a detailed diagram of the interfacial electronic structure has been constructed allowing determination of the charge transfer phenomena at the SnO_x/CuPc buried interface.

Our studies gave an important insight on how to synthesize SnO_x/CuPc heterojunctions for specific application. Within this work we provided a hint how to utilize parasite effects like oxide defects or surface carbon contamination in technology for passivation–like or heterojunction tuning-like processes.

References:
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