

TOP METAL CONTACT ON AN ORGANIC FILM: INDIUM ON COPPER PHTHALOCYANINE

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Properties of organic-based electronic devices are in a large extent affected by their metal-organic contacts. Thus, understanding the fundamental processes which occur at metal-organic interfaces is of great importance.

We have studied *in situ* the chemical and electronic structure of indium contact to copper phthalocyanine (CuPc) thin films by photoemission. Both core levels photoemission spectra (In 4*d*, C 1*s*, N 1*s*, O 1*s*) and valence band spectra were probed during the initial stages of the contact formation. The In 4*d* core level revealed a high-binding energy shifted component (Fig. 1, left panel) emerging at the lowest indium coverage. With the increased indium nominal thickness, the component diminishes, while the later emerging metallic component dominates. Such behaviour suggests a formation of a reactive layer at the indium-CuPc interface buried below a metallic indium [1].

However, the would-be reactive component is less pronounced if the system is probed with the higher photon energy of 335 eV (right panel), *i.e.* resulting in the larger probing depth. This suggests that the reactive component is not associated with the buried indium-CuPc interface, but with the surface of the probed system. The inconsistency is explained by the formation of inert indium nanoclusters residing on the CuPc surface [2]. Metal nanoclusters may display non-metallic behaviour in the photoemission process, *i.e.* their spectra may shift toward high binding energy due to the positive charge left on the cluster in the photoemission final state (*e.g.* Ref. [3]). The effect is tantamount to the chemical shift induced by chemical bonding.

New orbitals formed upon the indium deposition below the Fermi level – *i.e.* in the gap of the organic semiconductor (Fig. 2), and therefore commonly referred to as gap states – are supposed to reflect the reacted interface as well [1]. We show that the newly formed orbitals also come out from indium nanoclusters residing at the CuPc surface and lacking metallicity; their photoemission signal is simply superposed to the photoemission signal of the CuPc.

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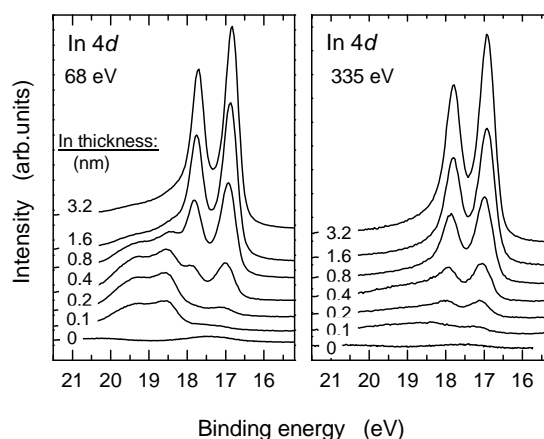


Figure 1. Evolution of the In 4*d* core level photoemission spectra recorded at photon energy of 68 eV and 335 eV upon step-like indium growth on the CuPc layer. The nominal indium thicknesses are given next to the spectra.

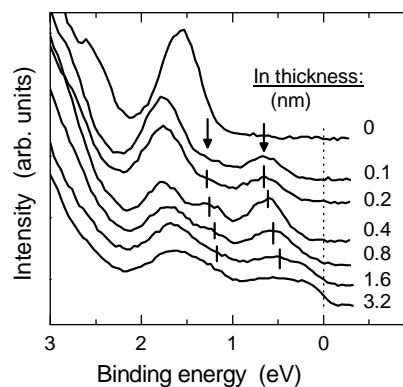


Figure 2. Evolution of the upper region of the valence band photoemission spectra recorded at a photon energy of 55 eV upon stepwise increased indium coverage. The ticks indicate new orbitals.