Copper phthalocyanine on InSb(111)A—interface bonding, growth mode and energy band alignment

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Abstract. The growth of the organic semiconductor CuPc on the InSb(111)A surface at 300 K has been studied using photoelectron spectroscopy. Core level emission data obtained using low energy synchrotron radiation reveal that the interface is abrupt with very weak bonding between the InSb surface atoms and the adsorbed molecules. The coverage dependence of the substrate and overlayer core level peak intensities follows the prediction of a uniform growth mode at high growth rates, but the organic film follows a Stranski–Krastanov growth mode at lower growth rates. C 1s and N 1s photoelectron emission data obtained with Mg K α radiation confirm that the CuPc molecules are intact within the layer, and shake-up satellites associated with benzene and pyrrole C and N peaks provide an insight into the energy and spatial distribution of the highest occupied and lowest unoccupied molecular orbitals. Photoelectron emission from the occupied bonding states of the CuPc and the valence band states of InSb provides the band offset for the filled states and the overall energy band profile for this organic–inorganic heterojunction. The presence of an interface dipole at the interface disproves a simple band alignment based on the vacuum level; the energy bands have a nested arrangement where both band edges in the InSb lie within the HOMO–LUMO gap of the CuPc.

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