

The initial interaction of Al₂O₃-ALD films deposited on CH₃NH₃PbI₃

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CH₃NH₃PbI₃ films show an increase in long-term stability and a protection against ambient conditions upon deposition of atomic layer deposited films of Al₂O₃ at room temperature [1,2]. In this work, the interaction of such Al₂O₃ (about one complete layer thick) film with the CH₃NH₃PbI₃ substrate is investigated using the photoemission spectroscopy offered at the MSB beamline [3] at the Elettra Synchrotron in Trieste (Italy). In particular, the Pb4f and I3d core levels, and the valence band states (Pb5d, O2p), as well as the O1s X-ray absorption spectra (XAS) are characterized.

An excitonic resonance in the O1s XAS spectrum and pronounced variations in the I3d/Pb4f ratio have been found. In addition, a Cooper minimum (CM) in the intensities of the O2p and Pb5d states is observed by varying the incident photon energy. The CM can be explained by the formation of iodine and of methyl-ammonium vacancies and a charge donation from the Al atom. It creates a Pb-derived symmetry in the O2p valence states of Al₂O₃ and also explains the observed reduced photoionization cross section for the I3d signals.

[1] M. Kot et al., ChemSusChem 9 (2016) 3401.

[2] M. Kot et al., Nucl. Instrum. Methods Phys. Res. B 411 (2017) 49.

[3] R. Vasina et al., Nucl. Instrum. Meth. A 467(2001) 561.