Preparation and in-system study of $SnCl_2$ precursor layers: First step towards the synthesis of Pb-free perovskites at EMIL

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Hybrid organic-inorganic metal halide perovskite-based solar cells – particularly those using $APbX_3$ ($A = CH_3NH_3^+$, $HC(NH_2)_2^+$, Cs^+ and $X = I^-$, Cl^-, Br^-) as the absorber layer – have demonstrated rapid improvement in power conversion efficiencies in recent years, reaching values in excess of 21% for lab-scale devices. A major concern related to this type of absorber is the toxicity of the Pb. Ongoing efforts to replace Pb by Sn have so far yielded relatively low-performing solar cells, likely limited by defect formation in the absorber material due to the tendency of Sn to oxidize from Sn^{+2} to Sn^{+4}. Preparing Sn-based perovskite films under vacuum conditions may be the key to inhibiting Sn oxidation and improving cell performance.

We present the first experimental results towards synthesizing Pb-free perovskite thin-films at the Energy Materials In-Situ Laboratory Berlin (EMIL). A detailed x-ray photoelectron and Auger electron spectroscopy study of $SnCl_2$ precursor layers of different thicknesses vacuum-deposited on Mo/glass substrates reveals significant changes in the chemical environment of Sn and Cl along the layer profile. These findings show the effect that substrate conditions can exert on the deposited material.