

Comparison of encapsulation properties of pyrene derivatives

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Abstract: Perovskite solar cells (PSCs) represent now rapidly emerging and highly promising photovoltaic technology with the best laboratory device efficiencies surpassing 25% threshold. While the efficiencies of PSCs come close to that of crystalline silicon solar cells, there is a severe gap in operation stability of these two types of photovoltaic devices. Silicon solar cells can operate for 25-40 years, while most of perovskite solar cells degrade within few thousand hours under continuous illumination. There is a growing evidence that stability of PSCs is strongly impacted by interfacial charge transport layers.

In particular, hole transport layer (HTL) is responsible for multiple degradation pathways discovered for PSCs. State-of-art HTLs require additional p-doping with oxygen and hydroscopic Li-salts, which impairs ambient stability of PSCs. Moreover, doped HTLs are intrinsically unstable in combination with complex lead halides since cationic species tend to oxidize I⁻ to molecular iodine. Therefore, designing new p-type materials enabling decent transport of positive charge carriers without additional doping is crucially important.

HTL should provide selective hole transport. Moreover, it might prevent migration of gaseous decomposition products of perovskite from the structure. Thus, good encapsulation properties of HTL are expected.

In this report an approach for comparison of encapsulation properties of different HTMs is given. Three materials were studied in bilayer films on the top of the perovskite. Samples with configuration glass/perovskite/HTL were exposed to constant illumination and temperature. The composition of the film was monitored through change in the absorbance of the film and phase composition on XRD.