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**Benefits and challenges for atomic layer deposition in organo-metal halide perovskite solar cells**

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Within the class of emerging photovoltaic technologies, organo-metal halide perovskite solar cells have exhibited a sky-rocketing conversion efficiency above 20% in just a few years.In this contribution I will address the opportunities which atomic layer deposition (ALD) offers to perovskite solar cells by highlighting the following merits: film growth conformality, engineering of charge transport layer/perovskite interfaces and compatibility with low-temperature processing. Specifically, two case studies will be presented:

- Extremely thin ALD $Al_2O_3$ layers (< 1 nm) conformally decorate the hybrid perovskite crystals and improve the environmental stability of the absorber, and well as lead to an increase in perovskite cell efficiency up to 18% (with respect to the pristine device of 15% efficiency).

- Plasma-assisted ALD $TiO_2$ is adopted in mesoscopic perovskite solar cells, with the purpose of suppressing charge recombination processes at the ITO/ mesoscopic scaffold/perovskite interface. The superior performance of 10 nm thick ALD $TiO_2$ layers with respect to conventionally adopted spray pyrolysis $TiO_2$ , is explained by a lower reverse dark current measured for ALD $TiO_2$. Electrochemical analysis points out a lower level of defects (i.e. pinholes) in ALD $TiO_2$, with respect to spray pyrolysis $TiO_2$, as key to suppress shunting paths leading to electron-hole recombination. Since ALD $TiO_2$ is carried out at temperatures below 150°C, flexible perovskite solar cells are tested, exhibiting a conversion efficiency of 10.8% under indoor illumination, comparable to the performance of flexible dye-sensitized solar cells.

This contribution will end by discussing the challenges yet to be met by ALD processing directly on the perovskite absorber, without affecting the opto-chemical and morphological perovskite properties.

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