Atomic Layer Deposition (ALD): a versatile conformal thin film deposition method with atomic-level control for next-generation PV devices

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Abstract

Photovoltaics are growing rapidly (+30-40% installed volume per year) and are facing many challenges (new usages, 4 to 8 TW capacity by 2050). Hence, academic and industrial communities are developing innovative solar cell architectures involving new materials and interfaces. To build such complicated devices, it is necessary to be able to synthesize nanomaterials with a fine control of the composition, thickness and morphology, under constrained conditions.

In this context, ALD (Atomic Layer Deposition) has emerged as a powerful tool because of its unique advantages that I will illustrate with examples in perovskite (PSC) and CIGS solar cells. Though PSC have reached very high efficiency levels, it is also accompanied by concerns on long-term stability and open questions about up scaled manufacturing. Innovative ALD-charge transport and encapsulation layers can contribute to circumvent those issues. In case of CIGS solar cells, ALD has been used to develop ultra-thin solar cells as well as encapsulation solutions. All these pave the way toward efficient semi-transparent, flexible and/or tandem systems.

In parallel, I will use those application examples to illustrate our efforts in understanding and controlling the growth of ALD functional materials.