The role of atomic layer deposited alumina on the perovskite solar cells' stability and efficiency

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In this work, we will show that the efficiency decrease of perovskite solar cells (PSCs) may originate from the creation of Frenkel pair defects in the perovskite film under illumination, and their movement across the solar cell.[1-2] The stronger the illumination, the higher the number of created Frenkel defects and their release from the perovskite absorber, leading to a faster efficiency decline and more substantial hysteresis in the j-V sweeps. However, once the perovskite film is covered by few cycles of atomic layer deposited (ALD) alumina[3-5], even at room temperature, it helps to self-heal the partially degraded perovskite film by successively blocking the flow of such ions across the charge transporting layers. This fact could also explain observation that the ALD-coated perovskite solar cell show negligible hysteresis after long-term operations, while the hysteresis index increases a lot in a case of the non-ALD-coated perovskite-based solar cells. Moreover, the ALD/perovskite-based PSCs show an increase of the initial efficiency over time, while it significantly decreases in the bare perovskite-based PSCs [6]. Therefore, the ALD process of TMA and water on perovskite[7-9] may be an extremely simple, fast and inexpensive way to overcome the long-term stability issue of PSCs and bring them to the market.

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