Oxide Buffer Layers for Perovskite Solar Cells Grown with a 200 mm Commercial ALD System Using Low-Temperature Process

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A set of perovskite solar cells were fabricated using buffer layers such as ZnO, Al_2O_3, and TiO_2 grown using atomic layer deposition (ALD). To avoid perovskite decomposition, the ALD growth process for the oxides was optimized for 100 ºC. The perovskite solar cells were made in an inverted structure on ITO coated glass. After the ITO layer, a hole-transport layer (HTL), perovskite absorber and an electron-transport layer (ETL) were coated in succession. The buffer layer was coated between the ETL layer and the back contact metal. The overall structure of the devices was Glass/ITO/HTL/Perovskite/ETL/ALD buffer layer/metal contact. As can be seen from the figure below that the device efficiency gradually increased as the buffer layer thickness increased. The best device performance was observed for a mixed buffer layer containing 9 nm thick ZnO layer followed by 1 nm Al_2O_3 layer. The improvement in the device efficiency was due to the increase in current density and fill factor after the introduction of the buffer layer. Increasing thickness of ZnO supported better charge extraction leading to high current densities and improving fill factor due to reduced shunting. Addition of Al_2O_3 (1nm) improved the current extraction even further.

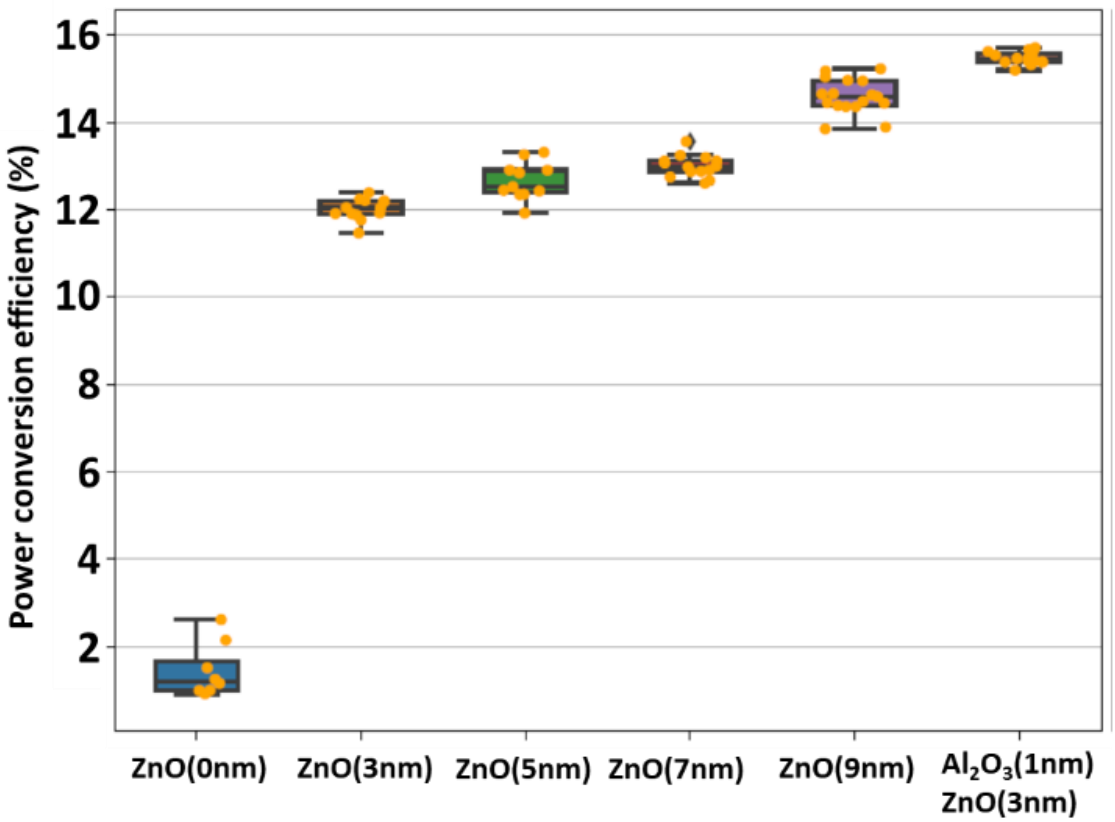

Figure 1. Comparison perovskite solar cell performance with different thicknesses of ZnO