Dynamic Chemical Passivation of Absorber Layer Trap States and its Real-time Effect on the Device Performance in Back-Contact Perovskite Solar Cells

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Hybrid organic-inorganic perovskites have been identified as one of the most promising classes of materials for photovoltaic and optoelectronic applications, due to their excellent electronic and optical properties, combined with their ease of fabrication. The efficiency of perovskite solar cells (PSCs) has increased at a remarkably fast pace, with the current maximum certified power conversion efficiency (PCE) reaching 25.2%. Conventional solid-state hybrid organic-inorganic perovskite-based solar cells have a sandwich type structure in which the perovskite absorber layer is positioned between bottom and top electrodes, typically a transparent conducting oxide (TCO) layer on glass, and an evaporated thin layer of gold or silver, respectively. Such an architecture for PCSs allows illumination of the cells only from the TCO side. Alternatively, the back-contact architecture offers the possibility of positioning both electrodes on one side of the absorber layer and shining light directly on the photoactive layer [1, 2]. This helps to avoid the occurrence of transmission losses caused by the charge collecting TCO electrode in the conventional sandwich structure for PSCs, and may have some potential application in constructing four or two terminal tandem solar cell devices. The back-contacted device architecture is also useful for conducting fundamental studies as it has an exposed photoactive area, permitting in situ measurements on the effects of chemical treatment, passivation and annealing. I will present a successful application of back-contact PSCs in studying the dynamic effect of a chemical passivation of the perovskite absorber layer and it is real-time influence on the device performance.

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References

[1] A. N. Jumabekov, E. Della Gaspera, Z.-Q. Xu, A. S. R. Chesman, J. van Embden, S. A. Bonke, Q. Bao, D. Vak, U. J. Mater. Chem. C 4, (2016) 3125-3130.
[2] L. M. Pazos-Outón, M. Szumilo, R. Lamboll, J. M. Richter, M. Crespo-Quesada, M. Abdi-Jalebi, H. J. Beeson, M. Vrućinić, M. Alsari, H. J. Snaith, B. Ehrler, R. H. Friend, F. Deschler, Science 351, (2016) 1430-1433.