Light Degradation of Planar Perovskite Solar Cells

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Abstract

Perovskite solar cells (PSCs) represent high power conversion efficiencies at potentially low material costs. This makes them a promising technology for new light harvesting applications, e.g. building integrated photovoltaics. However, their rather low light stability – which is not yet fully understood – remains a key challenge for their economical breakthrough.
In this work, high performing PSCs are fabricated (14-15% efficiency, up to 80% fill factor) and their light degradation is investigated. A material architecture similar to reported record devices is used, i.e. with TiO2 as electron transport layer and Spiro-MeOTAD as hole-transport layer. The performance of these devices is regularly measured (over a 750 h period of constant 1 sun illumination in inert N2), along with their chemical and optical properties before and after the light soaking.

It is observed that light stress induces two distinct power conversion efficiency losses: a 40% burn-in in the first 20 h, followed by a slower decay over the remaining 730 h. Furthermore, through systematic studies of various material layers and devices under light and electrical stress, we identify main origin of the burn-in.
Finally we propose material and design changes to produce light stable devices, as is necessary for the success of this technology.

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