Stability of organic-inorganic perovskite photovoltaic materials and devices under natural- and concentrated- sunlight

Iris Visoly-Fisher, Eugene A. Katz
Department of Solar Energy and Environmental Physics
Swiss Institute for Dryland Environmental and Energy Research
J. Blaustein Institutes for Desert Research, Sede Boqer Campus,
and Ilse Katz Inst. of Nano-Science and Technology,
Ben-Gurion University of the Negev

The greatest challenge facing the commercialization of perovskite- based solar cells (PSCs) is combining high efficiency and long-term stability. Concentrated natural sunlight was suggested for accelerated studies of lifetime and light-induced degradation. We recently demonstrated an experimental methodology with independent control of sunlight intensity, the sample temperature and environment during the exposure. Accelerated studies of perovskite PV materials showed a strong dependence of the stability on the materials composition, correlated with chemical bond strength, crystalline structures and defect density.[1,2] Several schemes were studied for filtering detrimental UV light for increasing the perovskite lifetime.[3]

Standard, outdoor operation of PSCs includes diurnal light/ dark cycling. Both reversible improvement and reversible degradation of PSC efficiency were observed under illumination-darkness cycling. Quantifying the performance and stability of cells exhibiting significant diurnal performance variation is challenging. We suggest that the figures of merit for photovoltaic performance and stability of such devices should be reconsidered. Instead of the classical approach of reporting the initial (or stabilized) efficiency value and the time required for its drop to 80% of the initial value (T80), we propose to use the value of the daily energy output generated during the first day/ illumination period, and the time needed for reaching its drop to 80%, respectively.[4] The latter accounts for both long-term irreversible degradation and the reversible diurnal efficiency variation, and does not depend on the type of degradation processes prevailing in a given PSC.

[1] **J. Phys. Chem. Lett. 6** (2015), 326−330.
[2] **ChemSusChem 9** (2016), 2572 – 2577.
[3] Submitted.
[4] Submitted.