ASIA-PACIFIC
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Hydrophobic Self-Assembling Monolayers for Stable Perovskite Solar Cells

Laura Canil[1], Antonio Abate[1]

[1]*Helmholtz-Zentrum Berlin, Albert-Einstein str. 16, 12489 Berlin, Germany*

laura.canil@helmholtz-berlin.de

With a power conversion efficiency over 22%, perovskite solar cells (PSCs) are considered a rising star in the solar energy. Nevertheless, the device long-term stability under working condition remains a big challenge. In particular, most of the halide perovskite compositions are highly sensible to moisture. Indeed, the initial device performances degrades abruptly in only a few days of air exposure.

Our strategy to enhance the moisture stability of PSCs is to functionalize the interface between the perovskite and the charge selective contacts within the device. We make use of specific molecule-to-substrate interaction to self-assembly perfluorinated small molecules on the perovskite surface. The formation of a nanometer thick perfluorinated layer results in hydrophobicity and potentially in super-hydrophobicity of the perovskite surface, which prevents the ingress of water from the atmosphere. Notably, such a functionalization can be done through scalable solution processing methods, which are compatible with fast output production including as roll-to-roll and inject printing. We investigate the impact of the functionalization on material and device stability, providing data from lab-scale devices aged in real working conditions – under light and voltage load. Our results show that the interface functionalization with perfluorinated molecules is an effective new approach to enhance PSCs lifetime.