Improving Stability of Lead Halide Perovskite Solar Cells based on 3D/2D Multi-dimensional Perovskite

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Abstract

The intrinsic instability of lead halide perovskite materials in the ambient atmosphere is one of the most critical issues that impede perovskite solar cell commercialization. In particular, photo-instability of these materials poses challenges for further developments in long-term device reliability for solar cell applications. To overcome these issues, multi-phase perovskites mixed with molecular spacer have recently emerged as promising candidates for hybrid perovskite photovoltaic cells with technologically relevant stability. However, bulky 2D cation mixed into 3D perovskite can give complexity for reliable morphology control, which should be studied thoroughly. In this work, we choose two types of 2D cations having various alkyl lengths and study how they incorporate into perovskite phase and affect photovoltaic device characteristics. Based on microscopic and spectroscopic characterization, we demonstrate that chain length of a 2D cation is strongly correlated with not only the integration into 3D perovskite phase and but also perovskite morphology. We also confirm that the vertical distribution of 2D cation in the perovskite layer impacts charge transport property and photovoltaic performance. Finally, we show that 2D-cation-encapsulation can passivate defects of perovskite, making perovskite-based solar cells highly stable under illumination. Our findings experimentally reveal the effect of 2D cation inclusion in perovskite materials and propose a general approach for improving the reliability of perovskite-based optoelectronic devices.

Keywords: *Perovskite Solar Cell, Defect passivation, Stability, Multi-dimensional perovskite*

Biography

Min Kim is a postdoctoral researcher working with Dr. Annamaria Petrozza in Center for Nano Science and Technology at Istituto Italiano di Teconologia in Milan, Italy. He received his PhD under the supervision of Prof Kilwon Cho from Pohang University of Science and Technology. His main research interests lie in the inorganic and inorganic/organic hybrid perovskite materials and stability of perovskite solar cells. Dr. Kim is granted a Marie Sklodowska Curie fellowship from EU Horizon 2020.