

Ambient-air Processed Perovskite Solar Cells Employing Effective Perovskite-NiO Nanoparticles Composite

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Here we develop solution-processed perovskite-NiO nanoparticles (MAPbI<sub>3</sub>-NiO NPs and MAPbI<sub>3</sub>-xClx-NiO NPs) composite films in ambient condition. Firstly, we report an air-stable, hole-conductor-free (HCF), high photocurrent PSC based on MAPbI<sub>3</sub>-NiO NPs composite, achieving a high PCE of 12.14 % and excellent air-stability over 60 days. [1] Furthermore, we employ a simple and effective interfacial engineering with metal oxide nanoparticles in PSCs based on MAPbI<sub>3</sub>-xClx-NiO NPs composite resulting in a high PCE exceeding 18.10 % and a remarkable air-stability over 210 days. [2] Subsequently, we achieved fully-ambient-processed stable and mesoscopic semitransparent PSCs by non-continuous islands-structure-MAPbI<sub>3</sub>-xClx-NiO NPs composite and interface engineering. XPS and IR spectra analysis revealed that Ni-O, Pb-O, C-O, Ni-N and N-NiO bonds attributed to strong chemical interaction between NiO and MAPbI<sub>3</sub> or MAPbI<sub>3</sub>-xClx-NiO NPs molecules enhance the air stability of MAPbI<sub>3</sub>-NiO composite based PSCs.