Development of Highly Durable Perovskite Solar Cells

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We present high stability of methyl ammonium (MA) lead triiodide perovskite ($MAPbI_3$) solar cells, with which we were able to study working mechanism using impedance spectroscopy and other techniques [1]. Especially, the devices with sputter–deposited polycrystalline NiO_x hole transport layer (HTL) and indium tin oxide (ITO) for both top and bottom electrodes showed excellent stabilities. Previously, we demonstrated high thermal stability of the $MAPbI_3$ perovskite devices with the NiOx HTL and glass encapsulations, showing no performance degradation at 85℃ over 1000 hours in dark using Cl-mediated interdiffusion method and MACl treatment approaches [2]. However, they still degraded gradually under 1 sun illumination for continuous power generation at maximum power point (MPP) [3].

Here, we demonstrate that the combination of the NiO_x HTL and the ITO for both top and bottom electrodes of the perovskite solar cells resulted in the highly stable semitransparent devices with the average visible light transmittance (AVT) above 16% and the power conversion efficiency (PCE) of 12.5%, showing no performance degradation over 4000 hours of continuous operation under 1 sun illumination at MPP (Figure 1). The combination of the transparency and the low-temperature solution possibility also allow us to develop tandem solar cells with the semi-transparent perovskite top layer and a low bandgap cells for bottom layers. Especially, with the highly efficient Si solar cells for the bottom layer it can possibly deliver tandem devices over 30% efficiencies in the future.

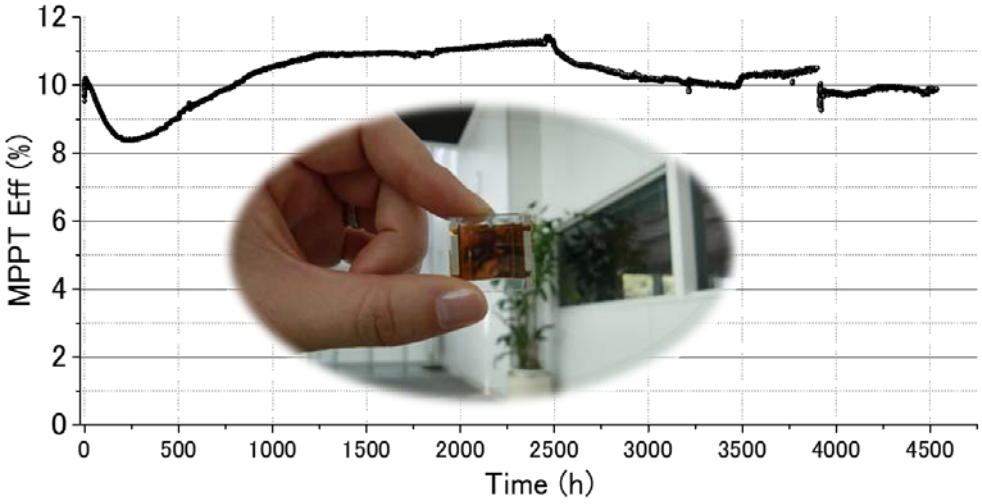

Figure 1: Continuous operation of highly durable semi-transparent perovskite solar cells

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Bibliography

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[2] DB. Khadka; Sustainable. Energy & Fuels, **1**, 755 (2017).

[3] MD. Islam; ACS. Omega., **2**, 2291 (2017).