Mixed 3D–2D Passivation Treatment for Mixed-Cation Lead Mixed-Halide Perovskite Solar Cells for Higher Efficiency and Better Stability

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［Introduction］ Despite the great success in performance improvement, instability is their major drawback preventing the commercialization of perovskite-based optoelectronic devices. Also, relatively high density of bulk defects and trap states can be formed in polycrystalline thin-film perovskite. Various methods for interface passivation between perovskite and hole transport layer have been investigated to improve both stability and photovoltaic performance. In this study, we applied a mixed passivation (MP) treatment that is effectively enhancing both power conversion efficiency and stability.

［Experiment］ Device structure adopted n-i-p structure with mesoporous TiO2 layer, using anti-solvent engineering in perovskite layer deposition. Dense&mesoporous TiO2 and Spiro-OMeTAD were used as electronic transport layer and hole transport layer, respectively. As electrodes, FTO and Au were employed as cathode and anode, respectively. Between perovskite layer and Spiro-OMeTAD layer, passivation treatment was applied using a mixture of bulky organic ammonium iodide (*iso*-butylammonium iodide, iBAI) and formammidinium iodide (FAI).

［Result and Discussion］ Figure1 shows device performances of reference and passivated devices. Passivation treatment was able to improve power conversion efficiency effectively. Power conversion efficiency of 21.7% that is the highest result among reports using bulky organic cation material to date. Not only J-V characteristics, device stability without encapsulation (relative humidity 75 ± 20%) improved significantly (Figure1 inset). Origin of these improvements will be discussed based on structural, optical and electronical analysis results.

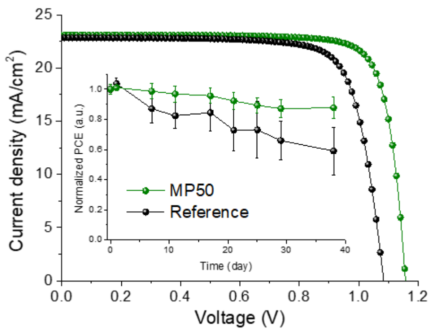

Figure 1. J-V curves of passivated device (green) and reference device (black). Inset table shows devices stability under relative humidity 75± 20% without encapsulation.

References

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