25.6% Certificated Efficiency of Perovskite Solar Cells Achieved

Perovskite solar cells (PSCs) have gained significant attention due to their low cost and high-efficiency advantages. After explosive development within the decade, the efficiency of single-junction PSCs and multi-junction perovskite-based solar cells are already beyond 25% and 30%, respectively. PSC ranks among the most potential photovoltaic technologies.

In halide PSCs, the formation of secondary-phase excess lead iodide (PbI_2) positively affects power conversion efficiency (PCE). Still, it can be detrimental to device stability and lead to large hysteresis effects in voltage sweeps.

In a study published in *Science*, the group led by Prof. YOU Jingbi from the Institute of Semiconductors (IOS) of the Chinese Academy of Sciences achieved 25.6% certificated efficiency of PSCs with good stability by using $(PbI_2)_2RbCl$ to stabilize the perovskite layer.

The researchers developed a small amount of rubidium chloride (RbCl) doping into perovskite materials. The doping converts the unstable and commonly used secondary phase PbI_2 into a new thermal and chemically stable $(PbI_2)_2RbCl$ (Figure 1A, 1B). It dramatically improves the thermal stability of perovskite material under 85°C conditions. It also enhances the ion-migration activation energy of perovskite material by three times. Thus the ion migration was effectively suppressed (Figure 1C, 1D).

By suppressing the PbI_2, the strong quantum confinement in the perovskite/PbI_2 interface eliminates the bandgap enlargement. As a result, it reduces the bandgap of the perovskite materials and expands the absorption range of sunlight.

Based on the obtained perovskite materials with high stability and optical absorption expansion, the researchers developed PSCs with a certification

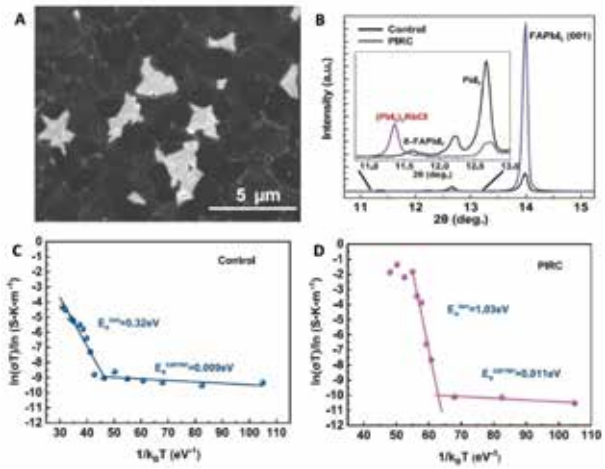

Figure 1. (A) SEM image of perovskite contained $(PbI_2)_2RbCl$ (PIRC). (B)XRD of perovskite without and with PIRC. (C and D) Temperature-dependent conductivity measurements of control and PIRC perovskite films, respectively. (Image by IOS)

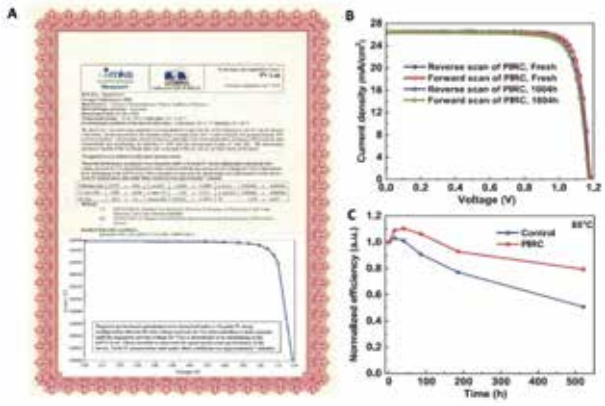

Figure 2. (A) Certificated results from an accredited photovoltaic certification laboratory (Newport, USA). The certificated efficiency is 25.6%. (Inset: Certification J-V curve of the device). (B) J-V curves of the PIRC-based device before and after aging in a nitrogen environment for 1004 hours. (C) Thermal stability (85°C) of the control and PIRC-based devices. (Image by IOS)

efficiency of 25.6% (Figure 2A), the highest efficiency of single-junction PSCs published. The devices retained 96% of their original PCE values after 1000 hours of shelf storage and 80% after 500 hours of thermal stability testing at 85°C (Figure 2B, 2C).

The findings of this study pave the way for the further development and industrialization of PSCs.

(IOS)

Reference

Zhao, Y., Ma, F., Qu, Z., et al. (2022). Inactive $(PbI_2)_2RbCl$ stabilizes perovskite films for efficient solar cells. *Science, 377*(6605), 531-534. doi:10.1126/science.abp8873