Correlation of Simulation and Experiment for High-Efficiency Perovskite Solar Cell (PV-3)

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Scientific Achievement:

We fabricated a highly efficient (17.5%), hysteresis-free $CH_3NH_3PbI_3$-based solar cell. We also developed a SCAPS-1D simulator model to understand the loss mechanism in solar cells.

Significance and Impact:

The SCAPS-1D simulator is used to understand and correlate the effect of defects on solar cell parameters. The model provides insights into the loss mechanisms of the high-efficiency perovskite solar cells and how to reduce the losses.

Research Details:

- Devices were fabricated with typical n-i-p structure involving FTO/c-TiO_2/m-TiO_2-PSK/Spiro/Au.
- The SCAPS-1D model was validated by comparing carrier lifetime of perovskite, current-voltage (J-V) characteristics in dark/light (Fig. 1), and capacitance-voltage (C-V) characteristics of the device.
- The effect of defect density at the perovskite/HTL interface (IL-1) and perovskite/ETL (IL-2) on device performance has been studied (Fig. 2).

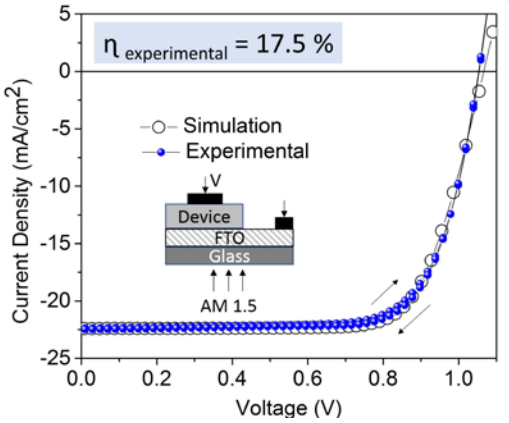

Figure 1. Light J-V characteristics measured and simulated at AM 1.5.

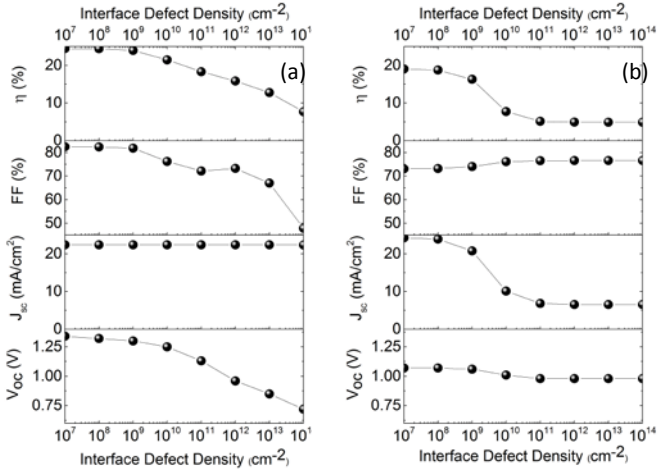

Figure 2. Variation of device parameters as a function of defect density at (a) IL1 and (b) IL2.

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