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High Open-Circuit Voltage Perovskite Solar Cells: Role of Surface Passivation

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Defect-induced recombination directly impacts perovskite photovoltaic performance, leading to reduced carrier lifetimes, and voltage loss.[1,2] These defects, caused by under-coordinated Pb and halide ions, must either be removed or passivated if cell efficiencies are to approach their theoretical limit.[2,3] Consequently, rational surface contact passivation techniques are critical for further improving the performance of the perovskite solar cells.[4-5] Here we introduce a double-side polymer passivation approach using ultrathin poly(methyl methacrylate) (PMMA) films. Photoluminescence imaging and transient spectroscopic measurements confirm a significant reduction in non-radiative recombination in the passivated cells, consistent with the voltage increase. Analysis of the molecular interactions between perovskite and PMMA reveals that the carbonyl (C=O) groups on the PMMA are responsible for the excellent passivation via Lewis-base electronic passivation of Pb^{2+} ions. As a result, we demonstrate very high-efficiency (~20.8%) perovskite cells with some of the highest open circuit voltages (1.22 V) reported for the same 1.6 eV bandgap.

References

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