nanomaterials

Supplementary Materials

$CuCrO_2$ Nanoparticles Incorporated into PTAA as a Hole Transport Layer for 85°C and Light Stabilities in Perovskite Solar Cells

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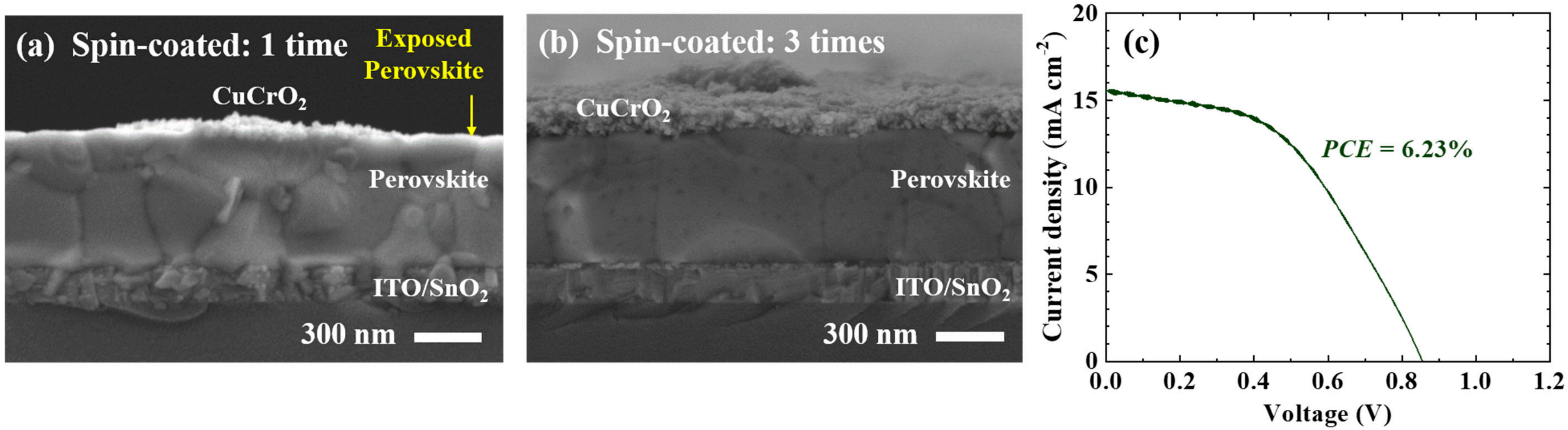

Figure S1. Solar cells adopting only $CuCrO_2$ as an HTL: (**a**,**b**) Cross-sectional scanning electron microscope (SEM) images of ITO/SnO_2/perovskite/$CuCrO_2$ films where $CuCrO_2$ nanoparticle solution is spin-coated on the perovskite 1 time and 3 times, respectively. The yellow arrow indicates exposed perovskite; (**c**) A J-V curve of the device using only $CuCrO_2$ as an HTL. The optimized number of spin coating is 3 times, where the device parameters are: V_{OC} = 0.855 V, J_{SC} = 15.58 mA cm^{-2}, FF = 0.471, and PCE = 6.23%.

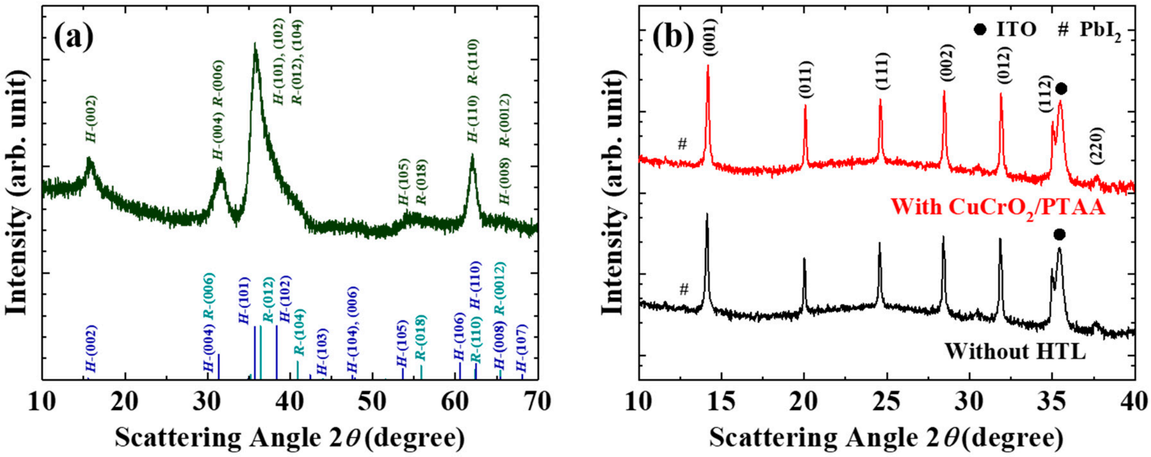

Figure S2. X-ray diffraction of $CuCrO_2$ nanoparticles and perovskite/$CuCrO_2$/PTAA HTL: (**a**) *R* and *H* stand for the rhombohedral (ICDD 01-074-0983) and hexagonal (ICDD 04-070-0746) $CuCrO_2$, respectively; (**b**) $Cs_{0.05}(FA_{0.85}MA_{0.15})_{0.95}Pb(I_{0.85}Br_{0.15})_3$ perovskite films with and without $CuCrO_2$/PTAA HTL.

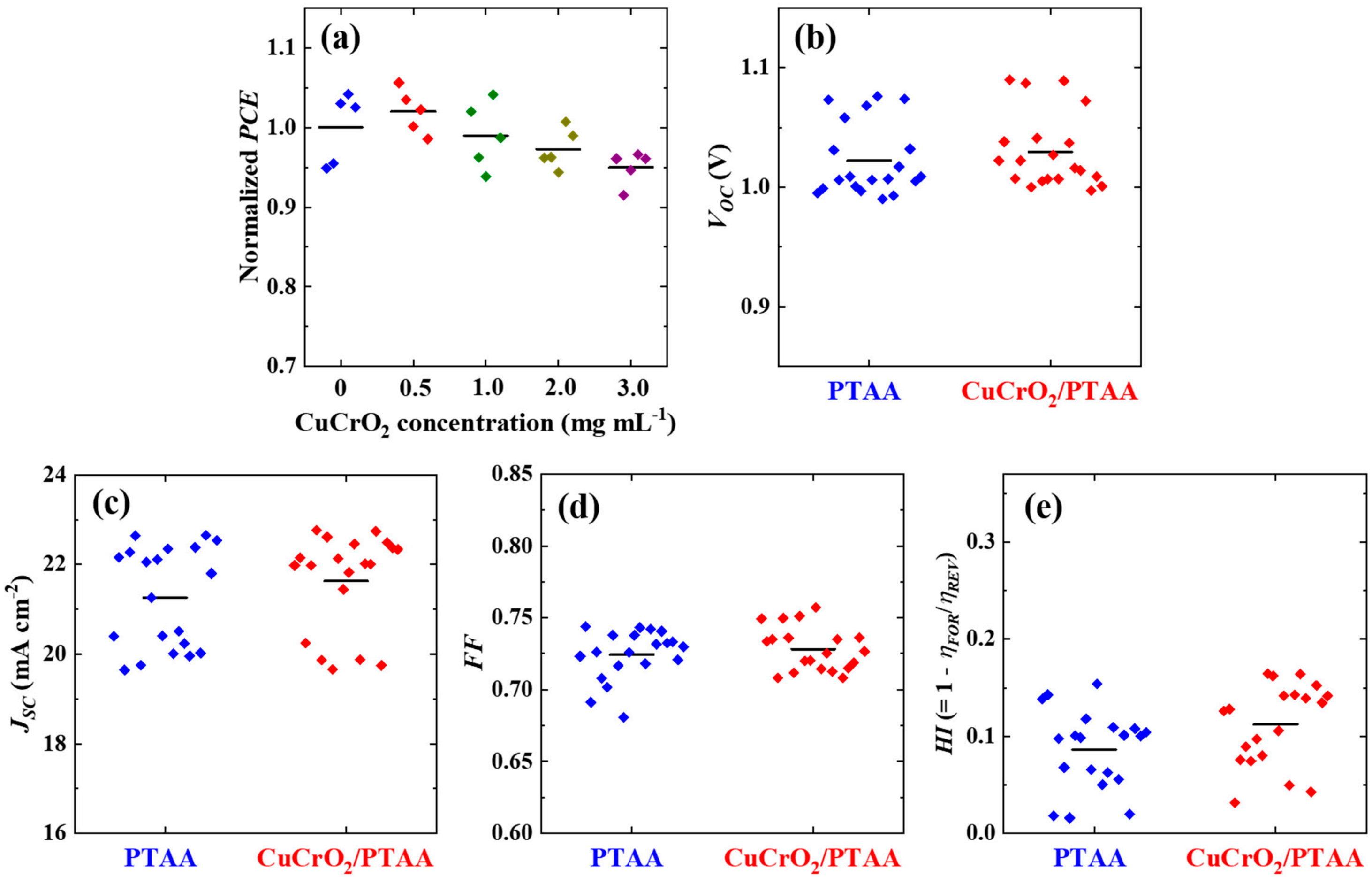

Figure S3. Performances of solar cells adopting either $CuCrO_2$/PTAA or PTAA as an HTL: (**a**) Efficiencies of solar cells using $CuCrO_2$/PTAA as an HTL with varying $CuCrO_2$ concentrations in the precursor dispersion; (**b**) V_{OC}, (**c**) J_{SC}, (**d**) FF, and (**e**) hysteresis index (HI = 1 − η_{FOR}/η_{REV}) of solar cells with the optimized $CuCrO_2$/PTAA vs. PTAA, measured for 20 devices at each condition (black lines representing average values).