Supporting Information

Photon Upconverting Solid Films with Improved Efficiency for Endowing Near-Infrared Sensitivity to Perovskite Solar Cells

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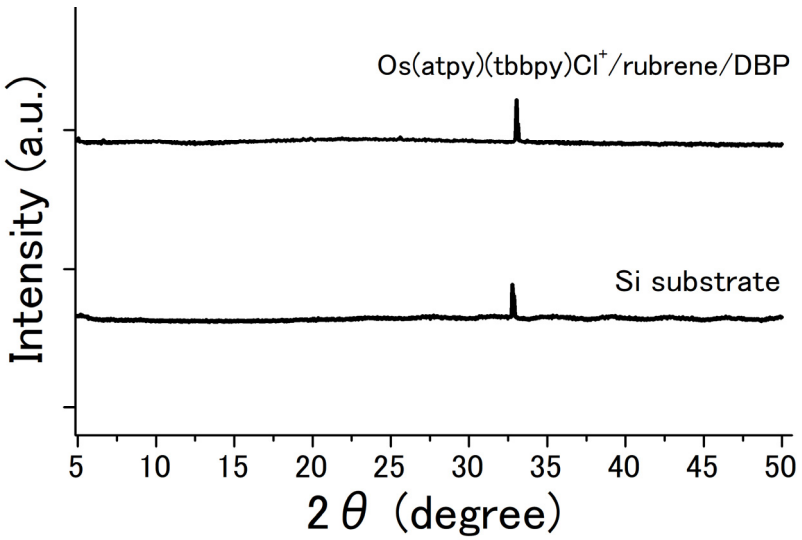

Figure S1. X-ray powder diffraction patterns of a Si substrate and Os(atpy)(tbbpy)Cl^+/rubrene/DBP nanoparticles on the Si substrate.

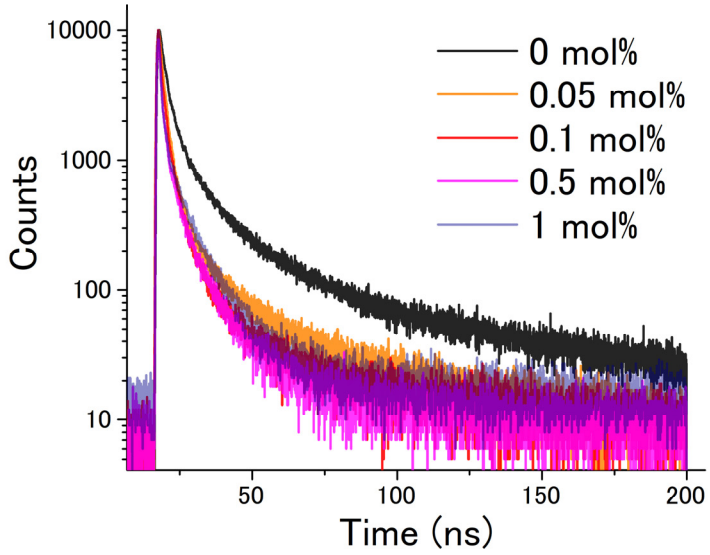

Figure S2. Fluorescence decays at 565 nm of the rubrene/DBP films with different DBP content (λ_{ex} = 470 nm). The increase of DBP ratio significantly shortened the fluorescence lifetime of acceptor rubrene due to the rubrene-to-DBP FRET.

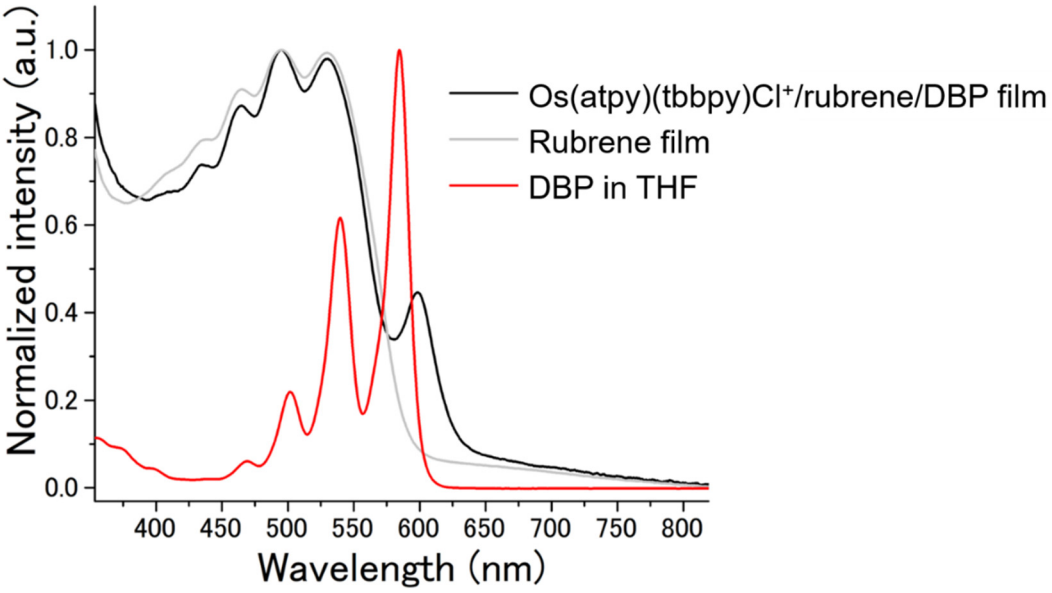

Figure S3. Absorption spectra of the rubrene and Os(atpy)(tbbpy)Cl^+/rubrene/DBP films and of DBP in THF solution. 462 nm and 598 nm light are used to selectively excite acceptor rubrene and collector DBP, respectively, in the Os(atpy)(tbbpy)Cl^+/rubrene/DBP film.

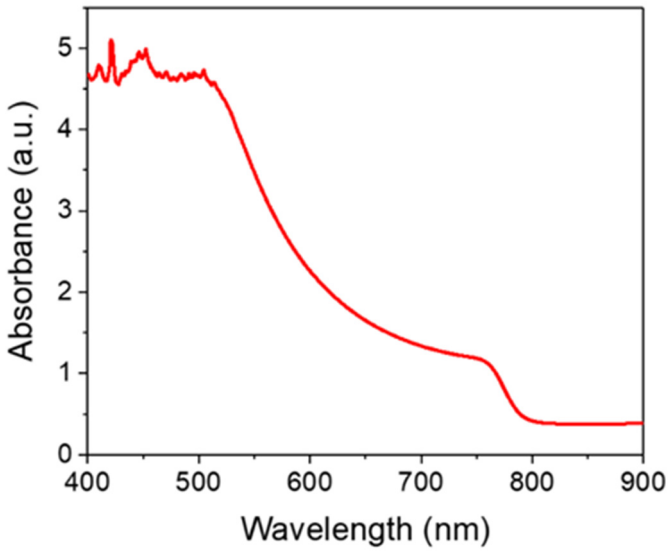

Figure S4. Absorption spectrum of the $Cs_{0.05}FA_{0.54}MA_{0.41}Pb(I_{0.98}Br_{0.02})_3$ film.

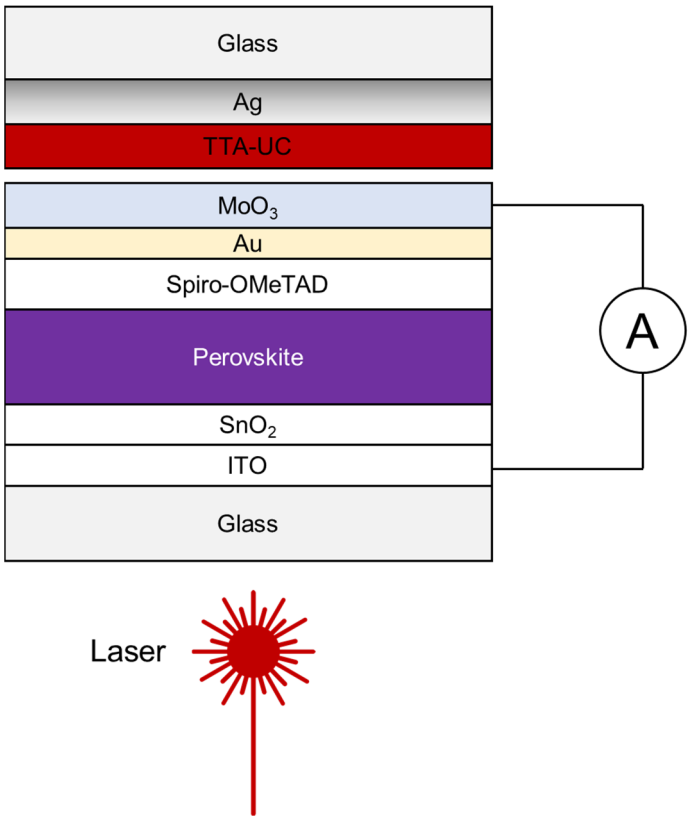

Figure S5. The device structure of the solar cell integrated with the TTA-UC film.

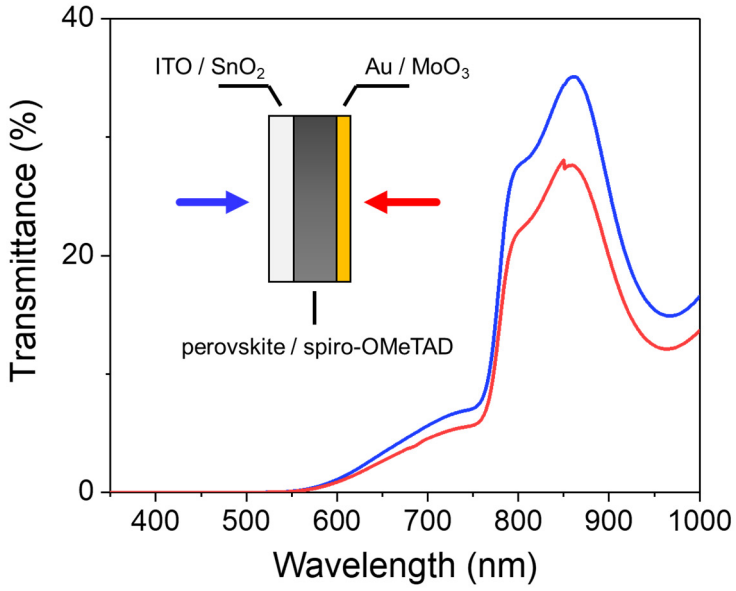

Figure S6. Transmission spectrum of the semi-transparent solar cell (ITO/SnO_2/ $Cs_{0.05}FA_{0.54}MA_{0.41}Pb(I_{0.98}Br_{0.02})_3$/spiro-OMeTAD/Au (15 nm)/MoO_3). The blue line depicts the transmittance entering the ITO side, and the red line shows transmittance from the Au / MoO_3 side.