Electronic Supplementary Material (ESI) for Journal of Materials Chemistry C.

Electronic Supporting Information

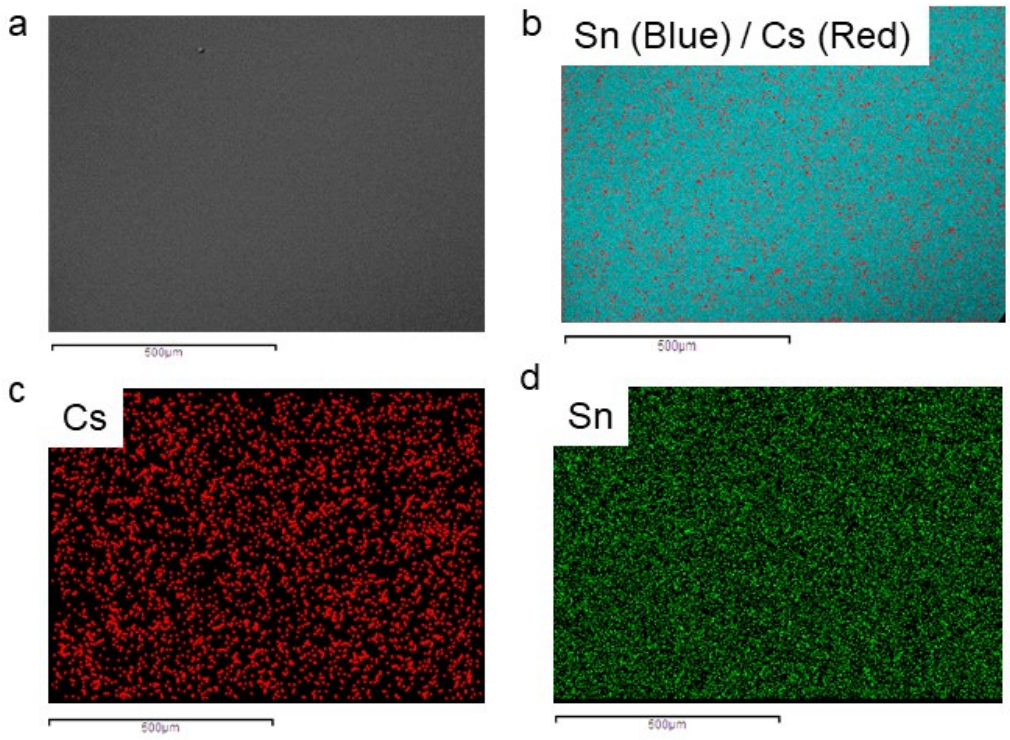

Figure S1.The surface of SnO_2/ CC a) SEM image b) EDX overlay of Cs (Red) and Sn (Blue) on SEM image, c) EDX mapping of Cs, d) EDX mapping of Sn

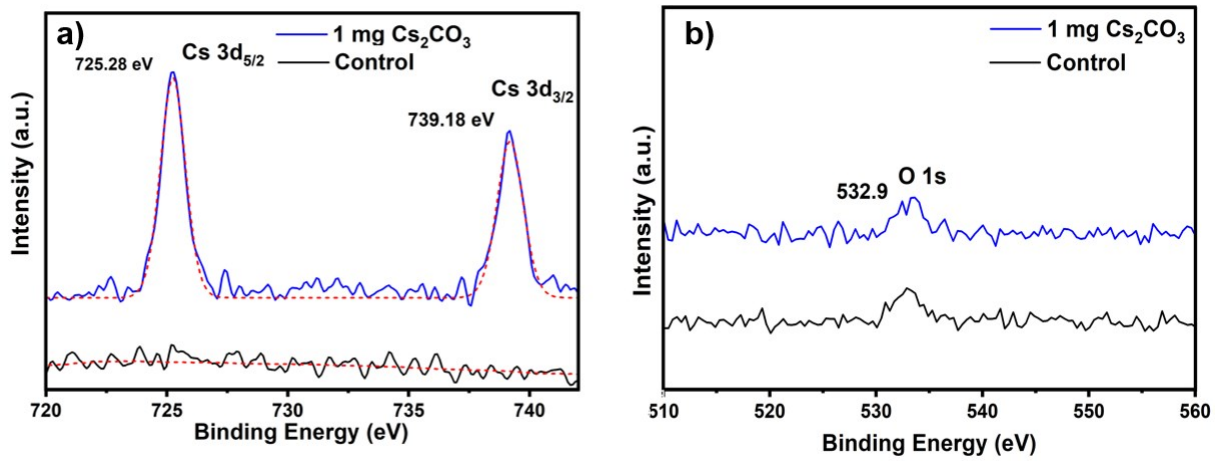

Figure S2. X-ray Photoelectron Spectroscopy (XPS) data of the (a) Cs 3d orbital and (b) O 1s orbital.

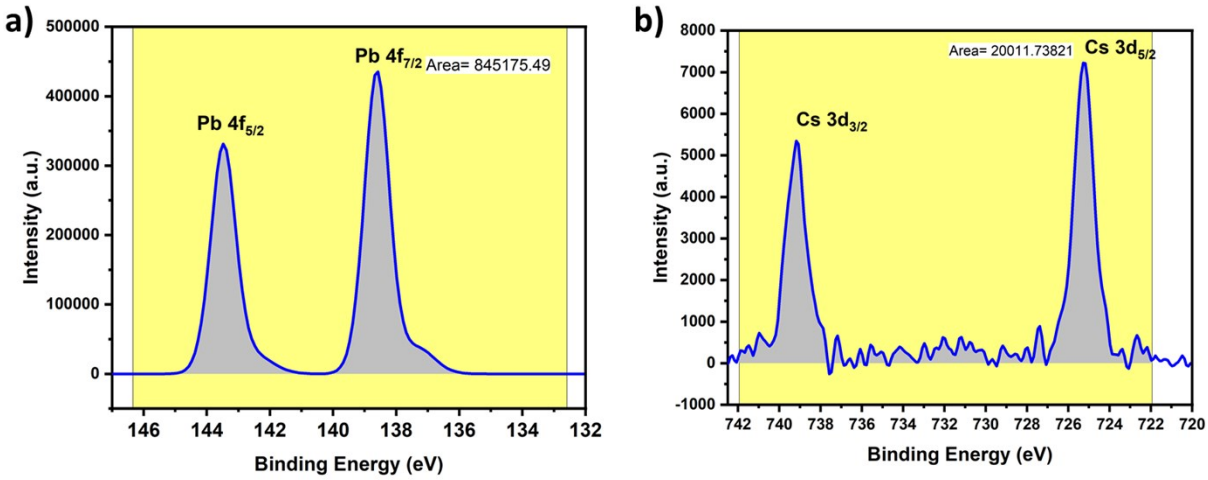

Figure S3. Integrated X-ray Photoelectron Spectroscopy (XPS) peaks of the a) Pb4f and b) Cs3d orbitals.

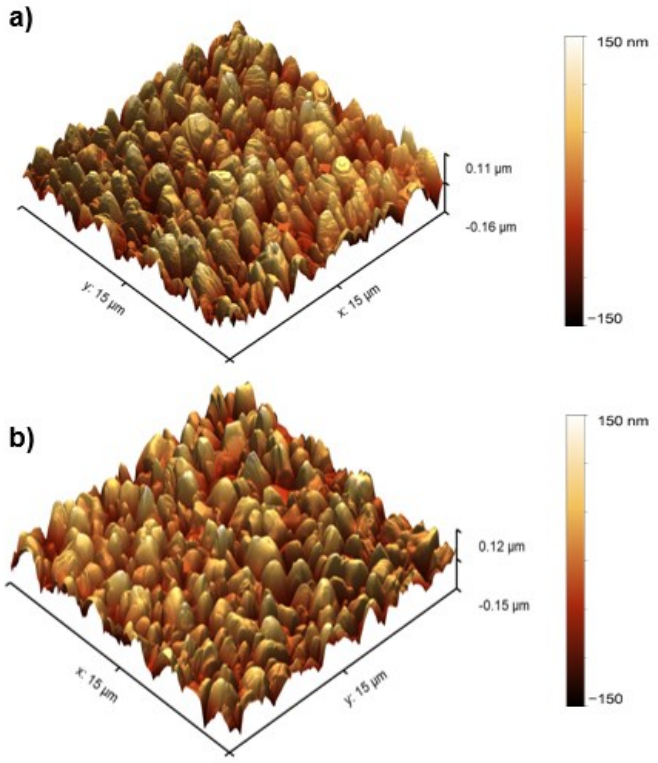

Figure S4. Three-dimensional atomic force microscopy (AFM) images of (a) SnO_2, and (b) SnO_2/CC deposited on ITO

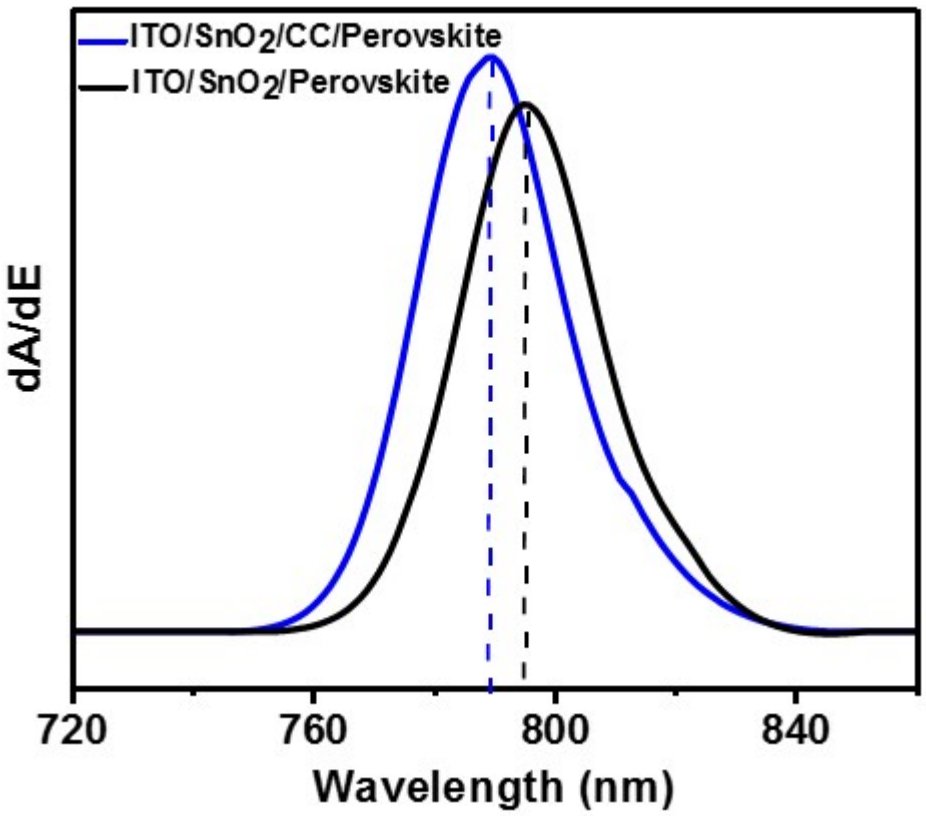

Figure S5. Plot of the background flattened differential of the absorption onset in films prepared with and without a CC interlayer.

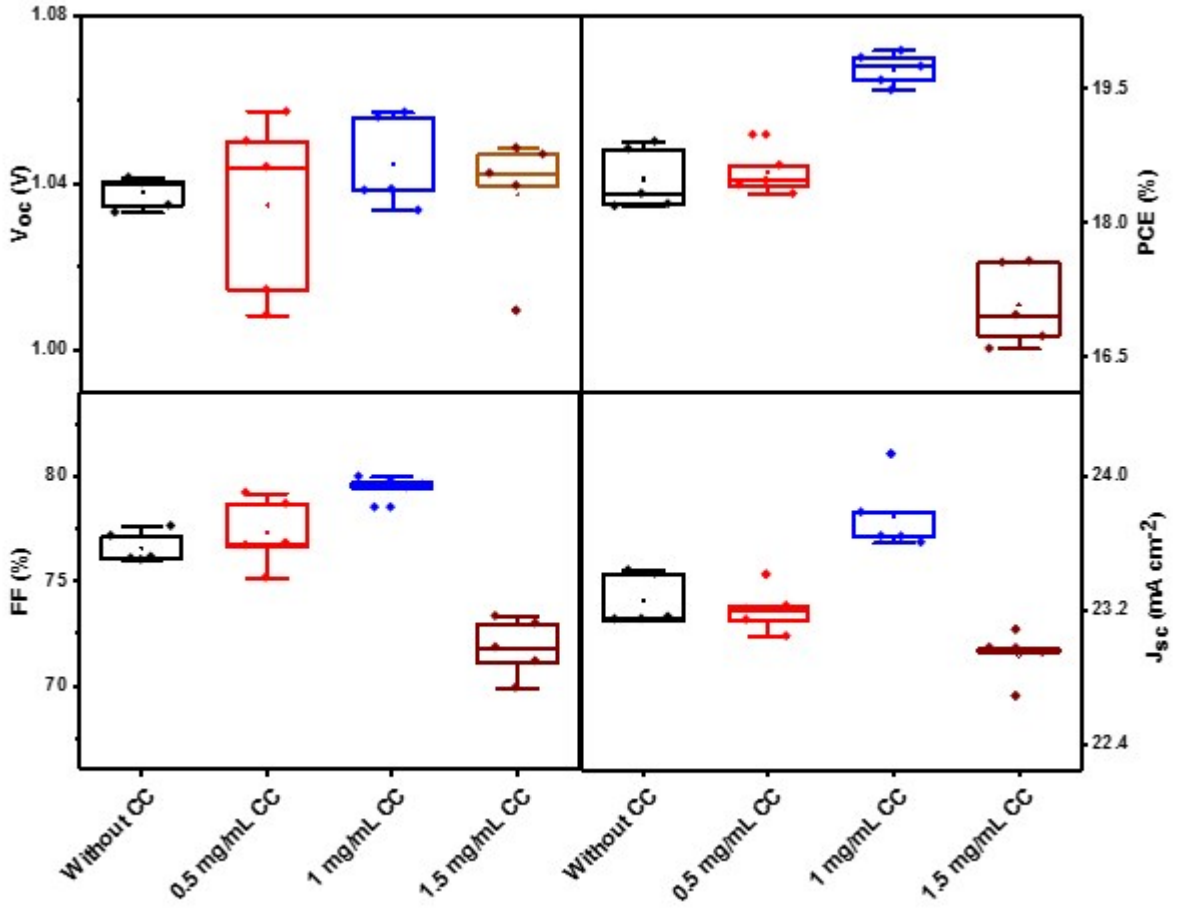

Figure S6.Photovoltaic parameters (PCE, *Voc*, FF, and *Jsc*) of solar cells at various concentrations of CC.

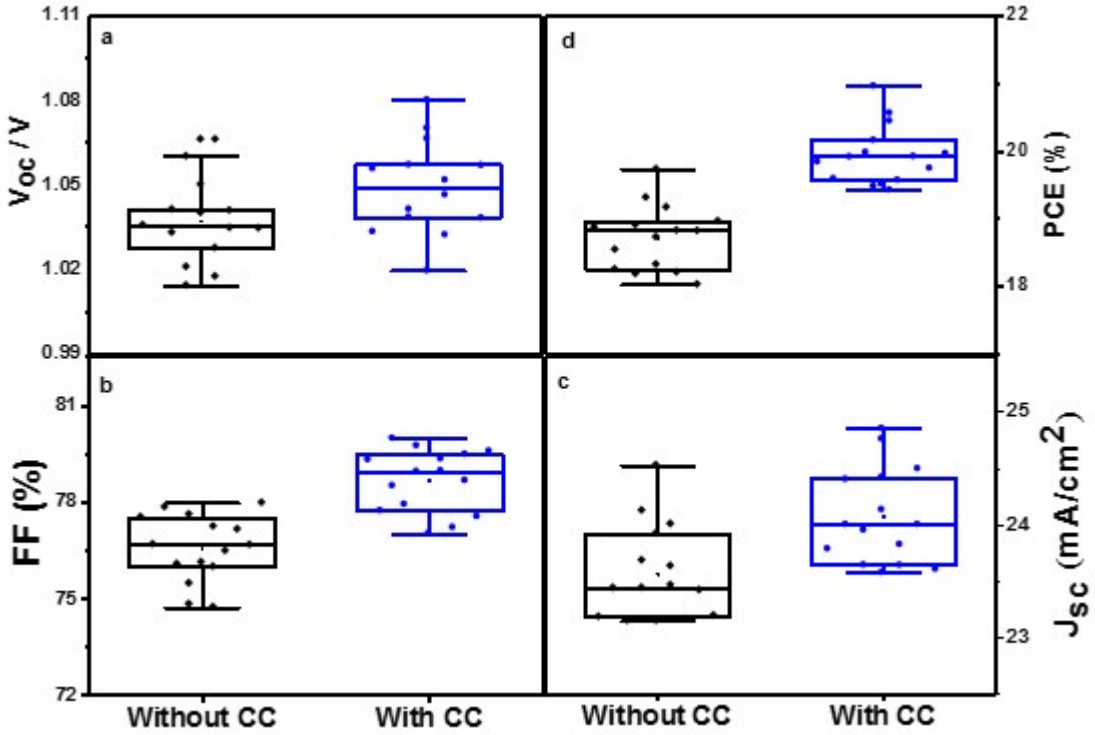

Figure S7. a) *Voc*, b) FF, c) *Jsc*, and d) PCE statistics of 15 devices with different ETLs measured with a scan rate of 20 mV s^{-1} without preconditioning, such as light soaking or long-term forward voltage biasing.

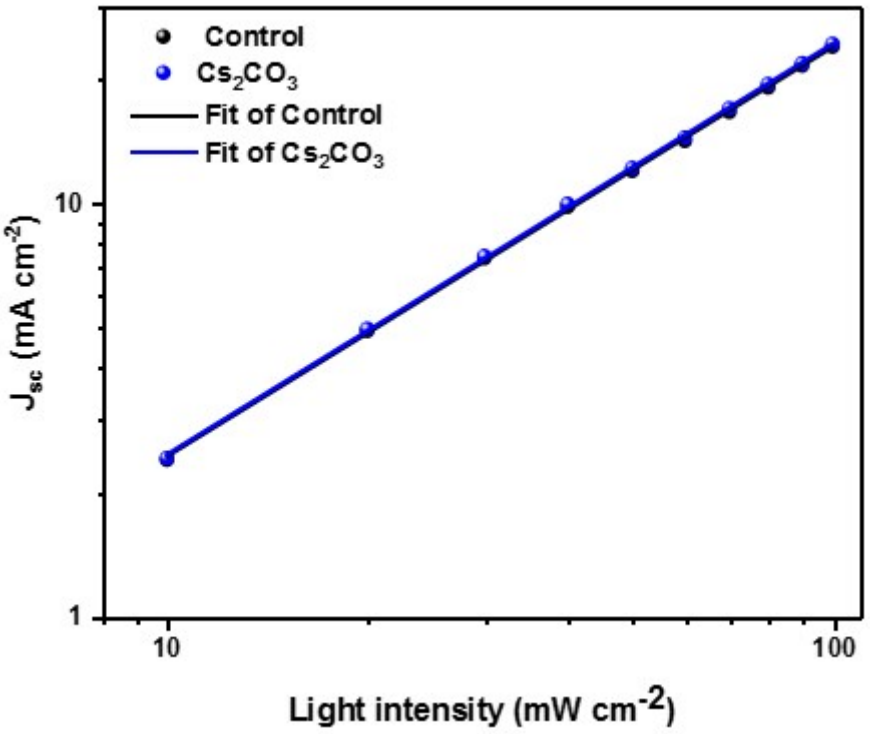

Figure S8. Light intensity-dependent *Jsc*

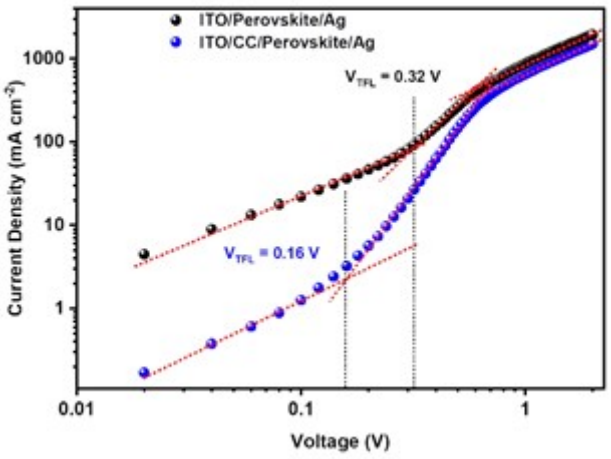

Figure S9. Current density–voltage characteristics of devices with the configuration of ITO/(without and with CC) /perovskite/Ag

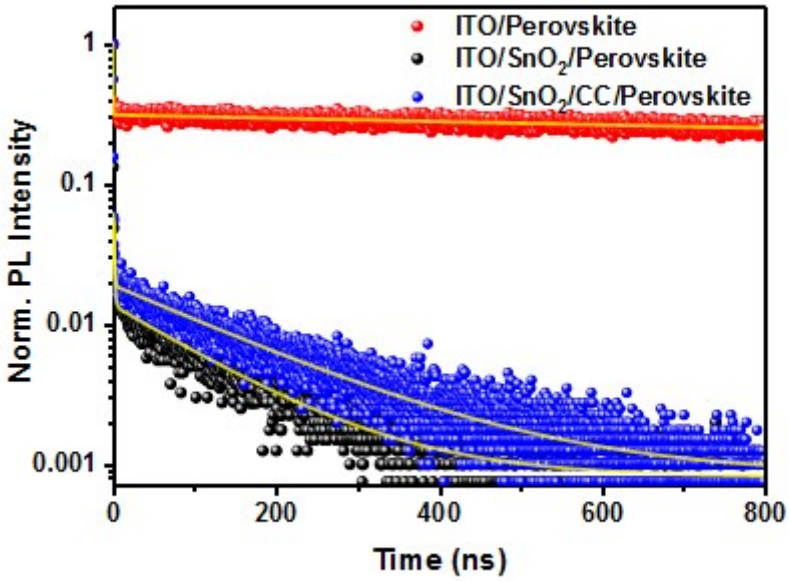

Figure S10. Time correlated single photon counting of perovskite films deposited on different ETLs.