Electronic Supplementary Information

Synthesis of Ultra-Stable Perovskite Composite Quantum Dots for Light-Emitting Diodes

Zhen Bao,[a,†] Yu-Chun Chang,[a,†] Hung-Chia Wang,[b] Yu-Chun Lee,[b] Tzong-Liang Tsai,[b] and Ru-Shi Liu[*,a,c,d]

[a]Department of Chemistry,National Taiwan University,Taipei 106, Taiwan

[b]Lextar Electronics Corporation, Hsinchu 300, Taiwan

[c]Advanced Research Center of Green Materials Science and Technology, National Taiwan University, Taipei 106, Taiwan

[d]Department of Mechanical Engineering and Graduate, Institute of Manufacturing Technology, National Taipei University of Technology, Taipei 106, Taiwan

† Z. Bao and Y.C. Chang contributed equally to this work.

Experimental Section

Chemicals and substrates

All chemicals, including cesium bromide (CsBr, Aldrich, 99.9%), lead bromide ($PbBr_2$, ABCR, 98%), and MCM-41 (Aldrich, 99.9%), were used without purification.

Synthesis of $CsPbBr_3@SiO_2$ composite

First, 1 mmol of CsBr, 1 mmol of $PbBr_2$, and 232 mg of porous material MCM-41 were loaded in a mortar. Then, the precursor powder was completely mixed by grinding. After grinding for 30 min, the mixed precursor powder was loaded into an Al_2O_3 crucible and then sent into a furnace. The sintering condition was set as needed.

Characterization

In-situ XRD was operated at the 01C2 experiment station in National Synchrotron Radiation Research Center, Hsinchu, Taiwan. PLQY was measured using an absolute PL quantum efficiency spectrometer (c11347, Hamamatsu). HRTEM images were recorded on a transmission electron microscope (JEOL-2100F). The PL spectra of the $CsPbBr_3/SiO_2$ NCs were measured with an FLS 1000 spectroscopy. For the cycling test of thermal stability test, we recorded the intensity of samples at 25 °C and 100 °C for each loop. The PLQY of the sample during the double-85 test was only recorded at room temperature after it cooled down every time.

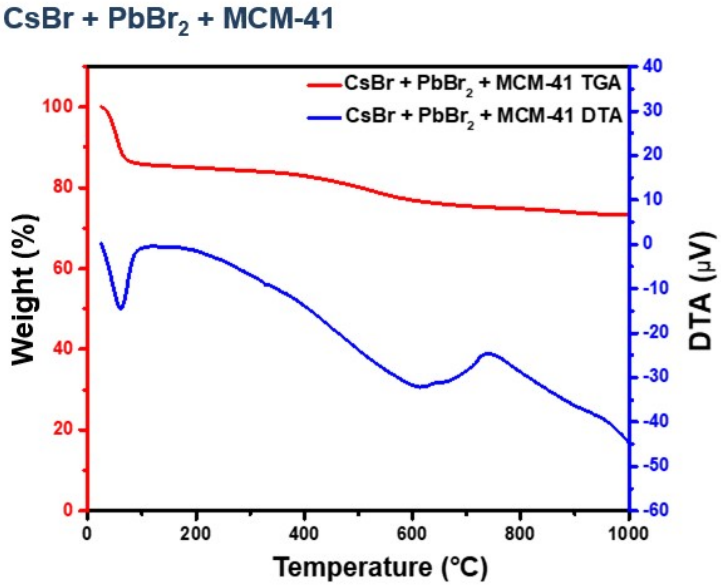

Figure S1. Thermogravimetric and differential thermal analysis diagram of the precursor of the mixture of MCM-41, CsBr, and $PbBr_2$

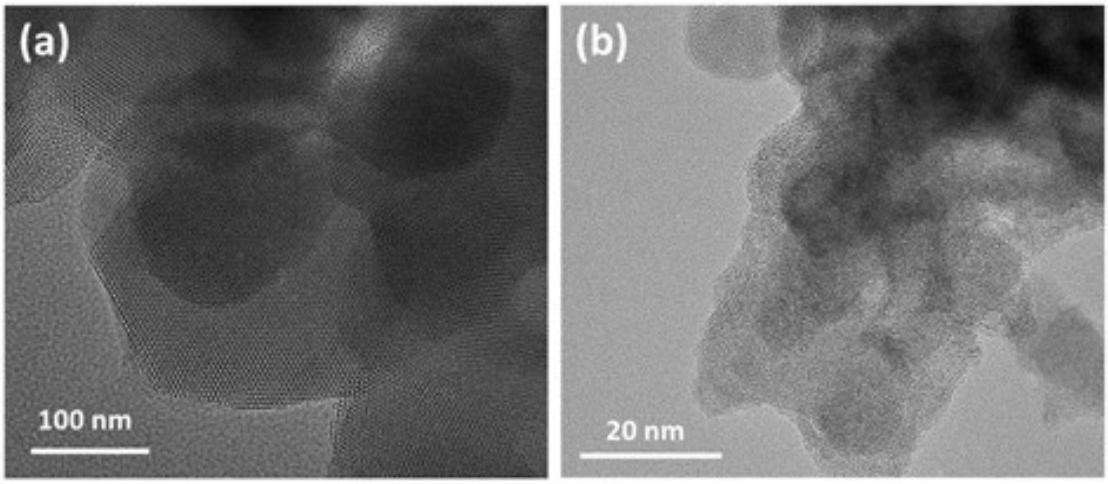

Figure S2. HRTEM images of the MCM-41 powder (a) before and (b) after the sintering at 600 °C.

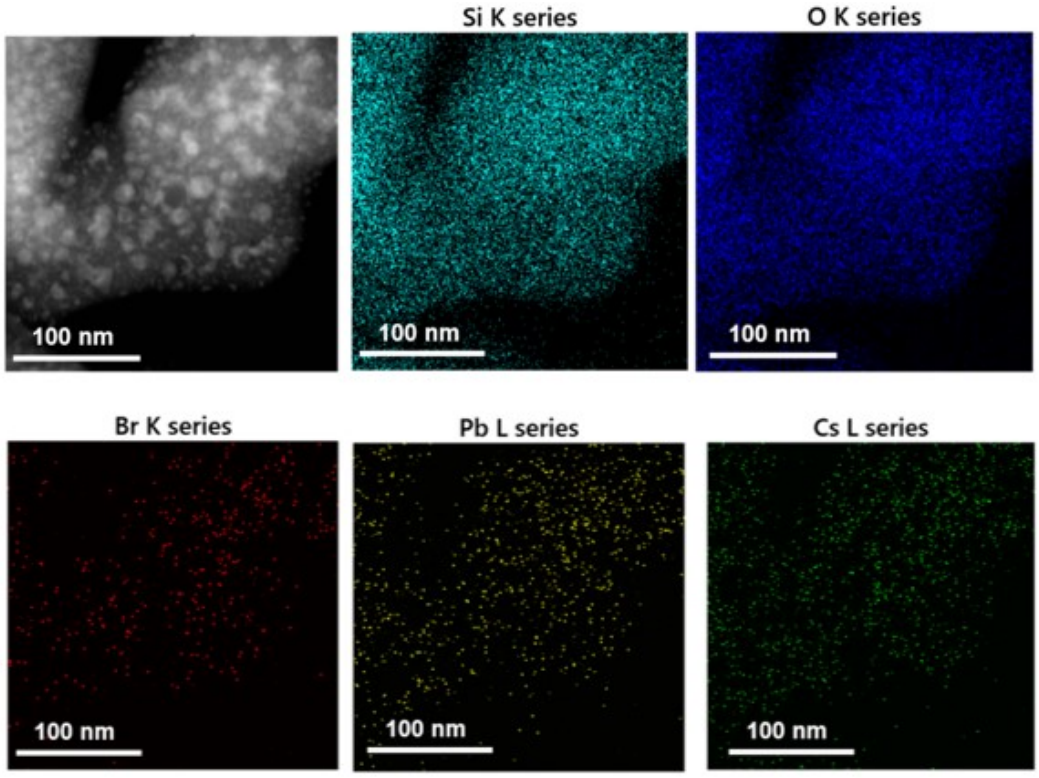

Figure S3. (a) SEM images and EDS mapping images of (b) Si, (c) O, (d) Br, (e) Pb, and (f) Cs from $CsPbBr_3@SiO_2$ synthesized with precursor ratio of $CsBr:PbBr_2 = 1:4$