

Photophysical Properties of Wavelength-Tunable Methylammonium Lead Halide Perovskite Nanocrystals

Supplemental Information

Daniel J. Freppon, Long Men, Sadie J. Burkhov, Jacob W, Petrich, Javier Vela*, Emily A. Smith*

The Ames Laboratory, U.S. Department of Energy, and Department of Chemistry, Iowa State
University, Ames, Iowa 50011-3111, United States

esmith1@iastate.edu, vela@iastate.edu

Transmission Electron Microscopy

Transmission Electron Microscopy (TEM). TEM was conducted using a FEI Technai G2 F20 field emission TEM operating at up to 200 kV with a point-to-point resolution of less than 0.25 nm and a line-to-line resolution of less than 0.10 nm. Samples were prepared by placing 2 or 3 drops of dilute toluene solutions onto carbon-coated copper grids.

Size and Morphology Analysis. Particle dimensions were measured manually and with ImageJ. Typically, more than 100 particles were counted in each case. Uncertainties in all measurements are reported as standard deviations.

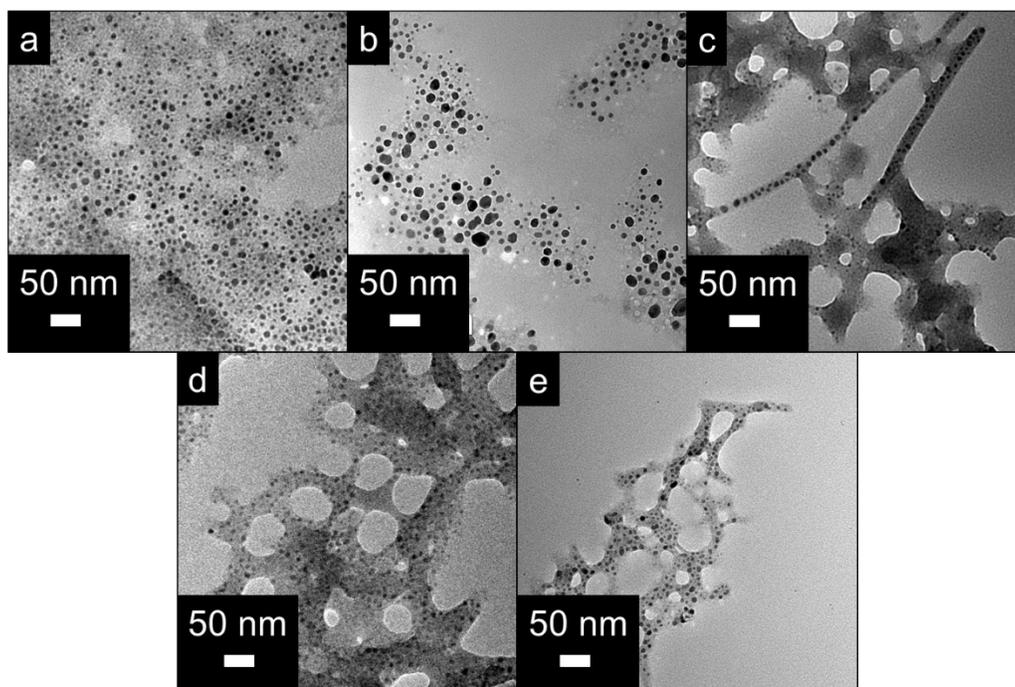


Figure S1. TEM images of (a) $\text{CH}_3\text{NH}_3\text{PbBr}_3$, (b) $\text{CH}_3\text{NH}_3\text{Pb}(\text{Br}_{0.75}\text{I}_{0.25})_3$, (c) $\text{CH}_3\text{NH}_3\text{Pb}(\text{Br}_{0.50}\text{I}_{0.50})_3$, (d) $\text{CH}_3\text{NH}_3\text{Pb}(\text{Br}_{0.25}\text{I}_{0.75})_3$, and (e) $\text{CH}_3\text{NH}_3\text{PbI}_3$ nanocrystals.

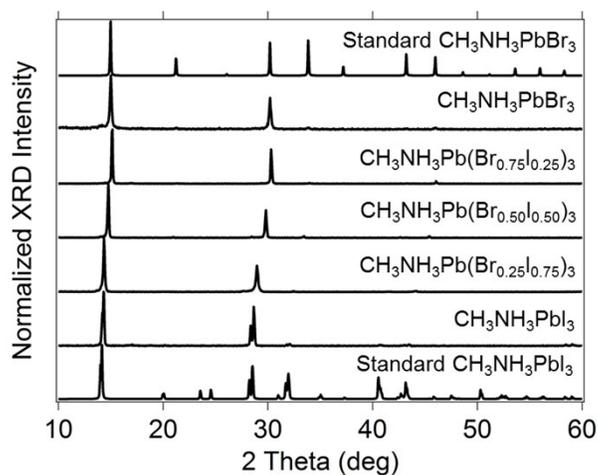


Figure S2. X-ray diffraction (XRD) patterns of $\text{CH}_3\text{NH}_3\text{PbBr}_3$, $\text{CH}_3\text{NH}_3\text{Pb}(\text{Br}_{0.75}\text{I}_{0.25})_3$, $\text{CH}_3\text{NH}_3\text{Pb}(\text{Br}_{0.50}\text{I}_{0.50})_3$, $\text{CH}_3\text{NH}_3\text{Pb}(\text{Br}_{0.25}\text{I}_{0.75})_3$, and $\text{CH}_3\text{NH}_3\text{PbI}_3$ nanocrystals. Also included are the standard XRD patterns for the cubic $\text{CH}_3\text{NH}_3\text{PbBr}_3$ and tetragonal $\text{CH}_3\text{NH}_3\text{PbI}_3$ crystal structures, respectively. The various halide percentages stated in the formulas represent synthetic loading rather than a measured composition of the nanocrystals.

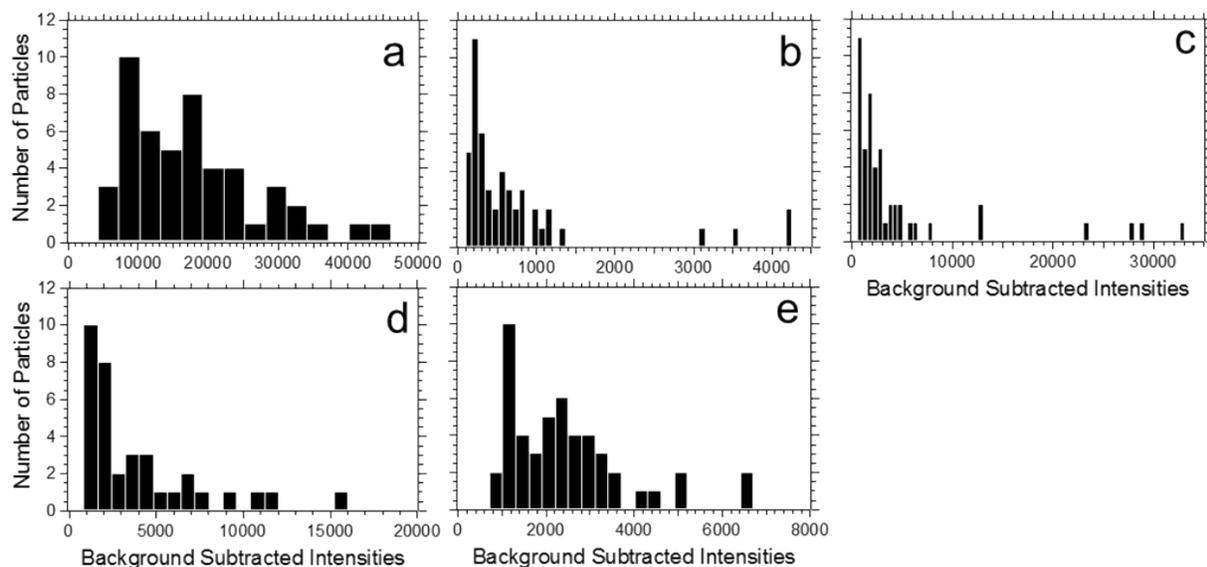


Figure S3. Histograms of the average background subtracted nanocrystal luminescence intensity for the perovskite compositions: (a) $\text{CH}_3\text{NH}_3\text{PbBr}_3$, (b) $\text{CH}_3\text{NH}_3\text{Pb}(\text{Br}_{0.75}\text{I}_{0.25})_3$, (c) $\text{CH}_3\text{NH}_3\text{Pb}(\text{Br}_{0.50}\text{I}_{0.50})_3$, (d) $\text{CH}_3\text{NH}_3\text{Pb}(\text{Br}_{0.25}\text{I}_{0.75})_3$, and (e) $\text{CH}_3\text{NH}_3\text{PbI}_3$. Each histogram was generated to have 10 or 11 nanocrystals as a maximum frequency, so the bin size varies among each composition. A total of 50 nanocrystals were analyzed in all cases except (d), which had 39 nanocrystals analyzed.

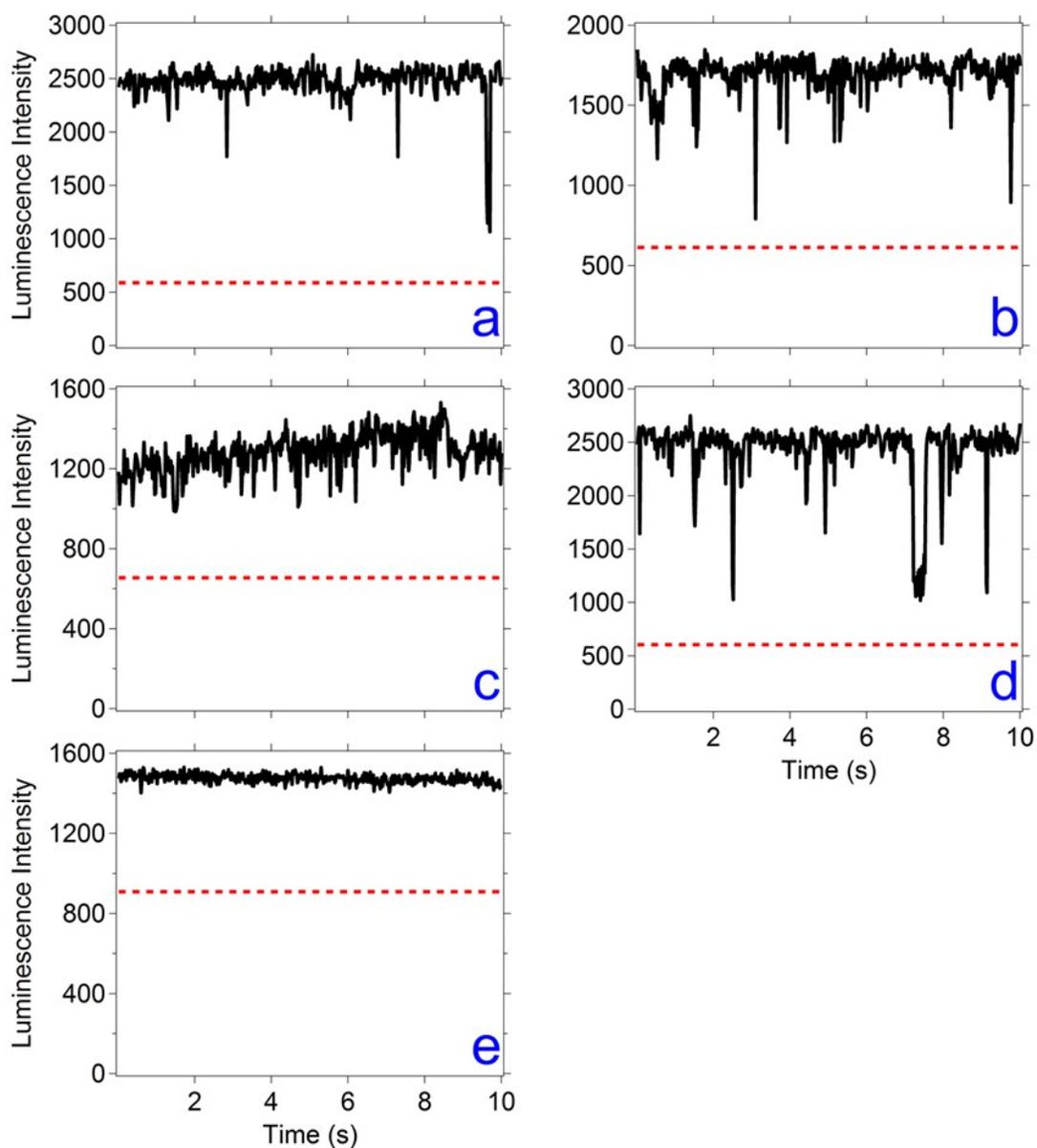


Figure S4. Representative luminescence intensity versus time graphs for (a) $\text{CH}_3\text{NH}_3\text{PbBr}_3$, (b) $\text{CH}_3\text{NH}_3\text{Pb}(\text{Br}_{0.75}\text{I}_{0.25})_3$, (c) $\text{CH}_3\text{NH}_3\text{Pb}(\text{Br}_{0.50}\text{I}_{0.50})_3$, (d) $\text{CH}_3\text{NH}_3\text{Pb}(\text{Br}_{0.25}\text{I}_{0.75})_3$, and (e) $\text{CH}_3\text{NH}_3\text{PbI}_3$ nanocrystals. The acquisition time is 20 ms, collected over 10 s. The dotted red line is the threshold for distinguishing nanocrystal luminescence from the background.