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Supplementary Materials

# Improving the Stability of Ball-Milled Lead Halide Perovskites via Ethanol/Water-Induced Phase Transition

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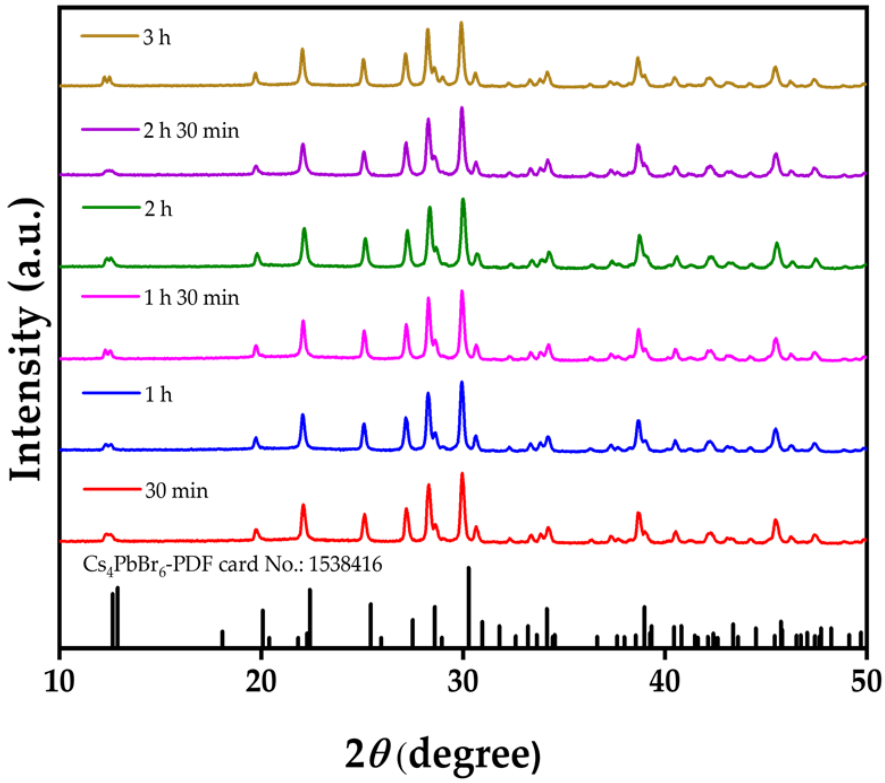


**Figure S1.** XRD patterns of $Cs_4PbBr_6$ NCs as a function of ball-milling time.

We measured ball milling time dependent XRD of $Cs_4PbBr_6$. The XRD data of $Cs_4PbBr_6$ ball milled for 30–180 min showed negligible difference. We applied 2 h of reaction time to make small and fully reacted perovskite microcrystals.

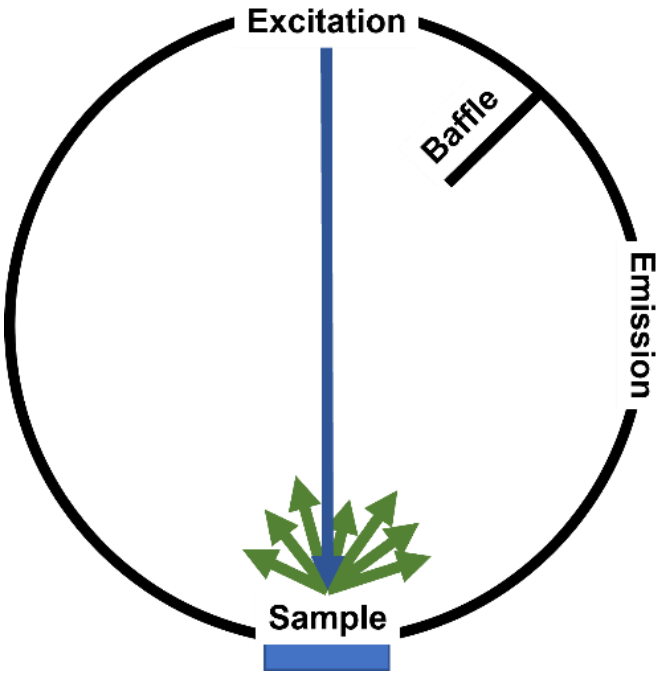


**Figure S2.** Illustration of integrating sphere.

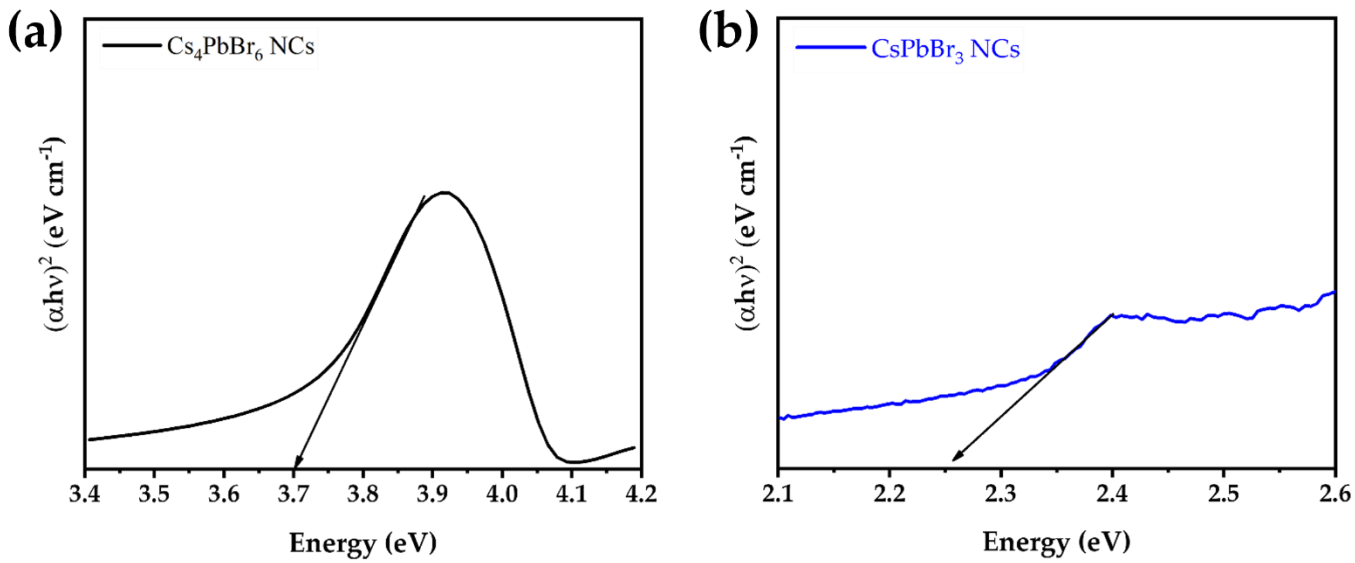


**Figure S3.** Tauc plot for determining the bandgaps of the (**a**) $Cs_4PbBr_6$ MCs, and (**b**) $CsPbBr_3$ MCs. The band gap energy was obtained by extrapolating the straight-line portion of the graph to zero absorption coefficients. The intercept on the energy axis indicates the value of band gap energy.

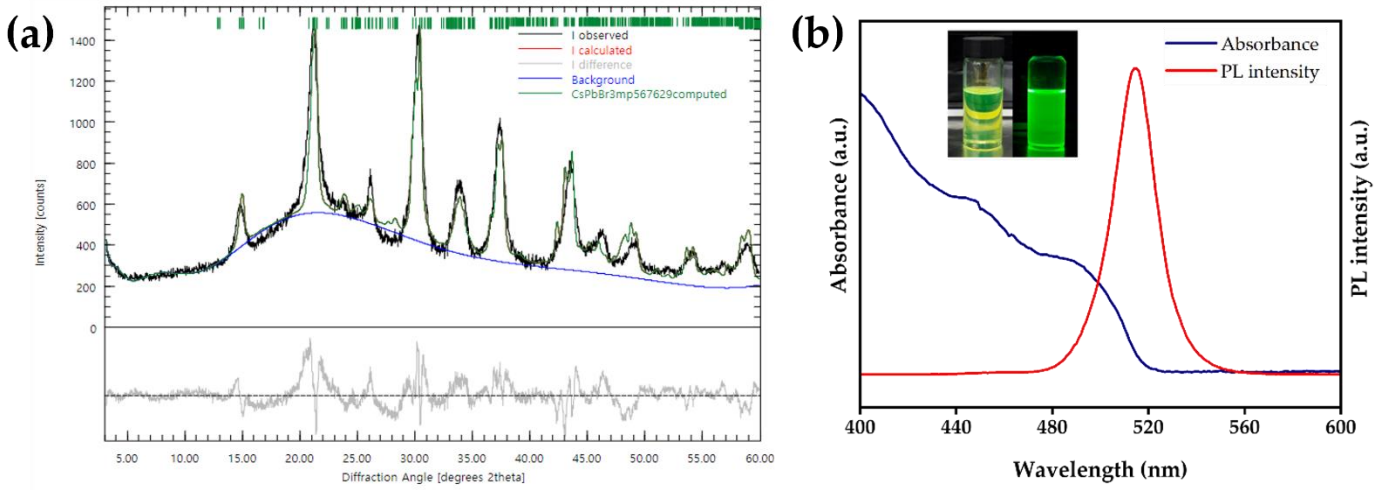


**Figure S4.** (**a**) Observed (black solid line), reference (green solid line), and difference (bottom gray line) powder X-ray diffraction (XRD) patterns for CsPbBr3, (**b**) absorption and PL spectra of $CsPbBr_3$ MCs obtained through hot-injection method comparison with ethanol/water-treated $CsPbBr_3$ MCs.

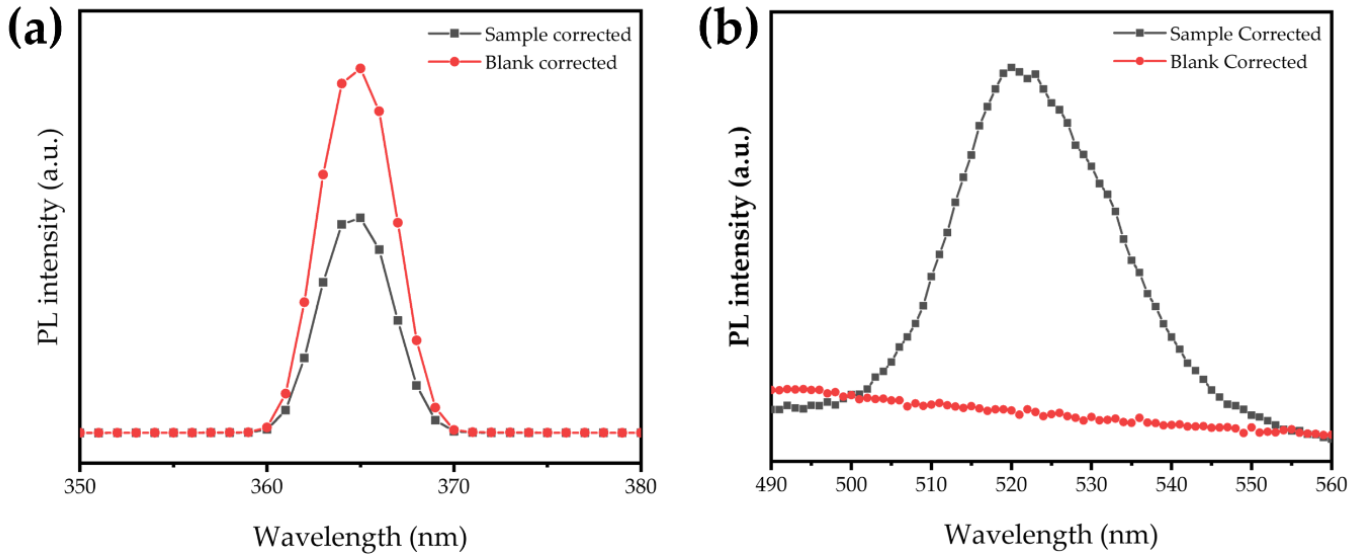


**Figure S5.** (**a**) Photoluminescence spectrum and (**b**) absorption spectrum for the measurement of photoluminescence quantum yield of CsPbBr3 MCs film.

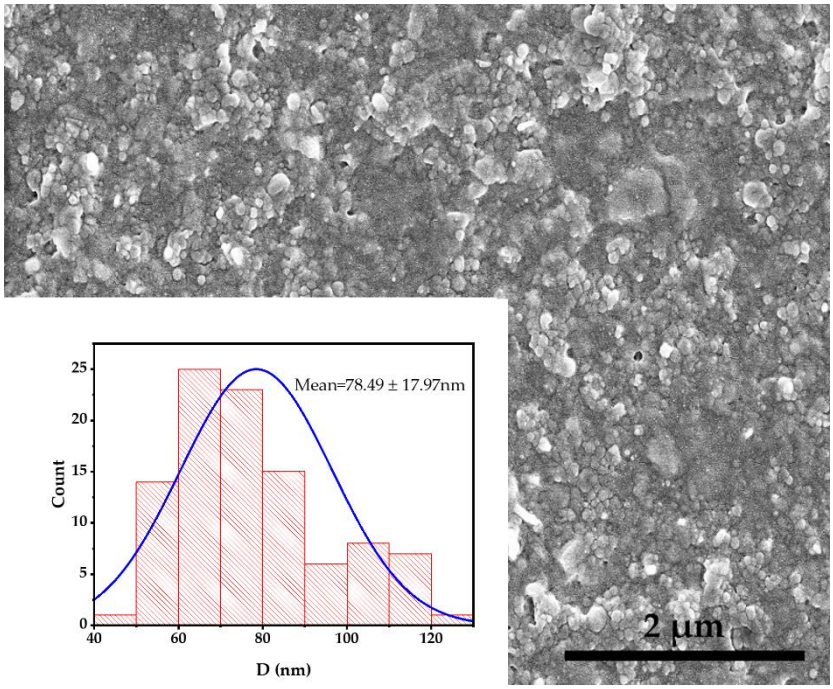


**Figure S6.** Scanning electron microscope (SEM) image and size distribution graph of $CsPbBr_3$ MCs obtained through ball milling process and ethanol/water treatment.