

Supporting Information

**Shape Controlled Water Assisted Synthesis of
Luminescent CsPb₂Br₅ 2D Perovskite Microcrystals
for High Responsive UV Detector**

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Experimental Section

Chemical Reagents

Cesium bromide (CsBr), Lead (II) bromide (99%) (PbBr₂), Titanium isopropoxide (TTIP 97%) oleylamine, and oleic acid were brought from Sigma Aldrich. Hexane, N, N-dimethylformamide (DMF), and Phenacyl Bromide were purchased from Rankem, SRL, and TCI, respectively. From SR Laboratories Pvt. Ltd., isopropanol (IPA, extra pure 99.5%). Hydrochloric acid (HCl) was purchased from Rankem. All these chemicals were used as received, without any further purification.

Synthesis of the perovskite material

First, in a 100 ml beaker 5 ml deionized water was poured and 500 μ l of HBr was added to the solution with constant stirring. Following to this we added 2 mmol of Phenacyl bromide and kept stirring for a few minutes. We added 200 μ l of oleic acid and 100 μ l of oleylamine followed by 2 mmol PbBr₂. When the solution was mixed properly after a few minutes of stirring, we got a homogenous white solution. Then we added 5.5 mmol of CsBr into it and the solution was stirred for another 1 hour. We added 5 ml of acetone into the as-synthesized solution and sonicated it properly to get a uniform mixture. That white solution was kept for 15-20 min to settle down and the precipitated white solid was collected by centrifugation and redispersed in hexane for further characterization.

Device fabrication process

To prepare the photodetector device, a compact TiO₂ electron transport layer (ETL) was first deposited on the FTO-coated glass using a previously described method.¹ Briefly, 369 μ l TTIP was added dropwise to 2.53 ml IPA while stirring. A 0.013 M HCl solution in IPA was prepared by adding 35 μ l 2 M HCl to 2.53 ml IPA in a separate vial. After stirring the TTIP solution for one

hour, HCl solution was added dropwise into the TTIP solution with continuous vigorous stirring. After stirring for 3 h the compact TiO₂ ETL film was deposited on the FTO glass using a spin coater at 3000 rpm for 30 sec. Furthermore, to dry the film, the coated substrates were placed on a hot plate at 100 °C for 30 min and then finally annealed at 480 °C for 30 min. To prepare the active film of the photodetector device, hexane-suspended (10 mg/ml) CsPb₂Br₅ NCs were spun on TiO₂-coated FTO glass at 2000 rpm for 30 sec and dried at 80 °C on a hot plate in the air. The gold counter metal electrode was sputtered on top of the prepared CsPb₂Br₅ NCs film. Using a mask, the area of the devices was kept at 2mm×2mm (0.04 cm²).

Characterization techniques

Absorption and emission spectroscopy

The ultra violet- visible (UV-Vis) spectra were acquired on a Shimadzu UV-Vis 2450 spectrometer in the range of 200-800 nm for absorbance data. A fluoromax-4C spectrophotometer by Agilent was used to record the photoluminescence and excitation spectra. The range in which the PL spectra were recorded was 320-580 nm with a slit width of 2.5 and in a medium scan.

Powder X-ray Diffraction (P-XRD) measurement

Powder XRD was acquired by a Rigaku Smart Lab automated multipurpose X-ray diffractometer in the range of $2\theta = 10-50^\circ$ with a wavelength of 0.154 nm (Cu K α) and the acceleration voltage was 9kW.

Field Emission Scanning Electron Microscope (FE-SEM)

The morphological analysis of our sample was performed on Carl Zeiss Gemini and Carl Zeiss Ultra plus FE-SEM where the operating voltage was kept at 20 kV.

High resolution-Transmission Electron Microscopy (HR-TEM)

The morphological and structural characteristics were investigated by JEM 2100 TEM.

X-Ray Photoelectron Spectroscopy (XPS)

The elemental analysis was done using PHI 5000 Versa Probe III model of XPS.

Thermogravimetric analysis (TGA)

The thermal stability was carried out in the range of 0-1000°C on SII 6300 EXSTAR with a heating ramp of 10°C/ min.

Time-Correlated Single Photon Counting (TCSPC)

The lifetime measurement of our sample was done on FLS-1000-xs-t by Edinburgh Instruments. The excitation source was a 340 nm pulsed light-emitting diode (EPLED).

Element	Atomic %
Br	62.83
Cs	13.12
Pb	24.05

Table S1. Atomic percentage of CsPb₂Br₅ composite.

A ₁	A ₂	A ₃	τ_1	τ_2	τ_3	τ_{avg}
438.2006	471.0295	108.782	2.36E-09	6.66E-09	1.97E-08	1.04E-08

Table S2. TCSPC lifetime data.

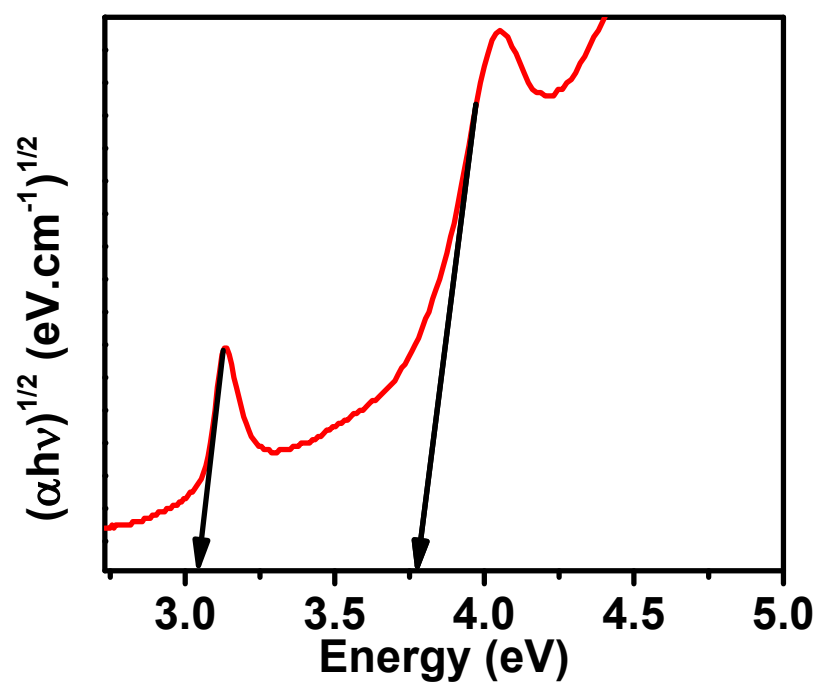


Figure S1. Tauc Plot of CsPb₂Br₅

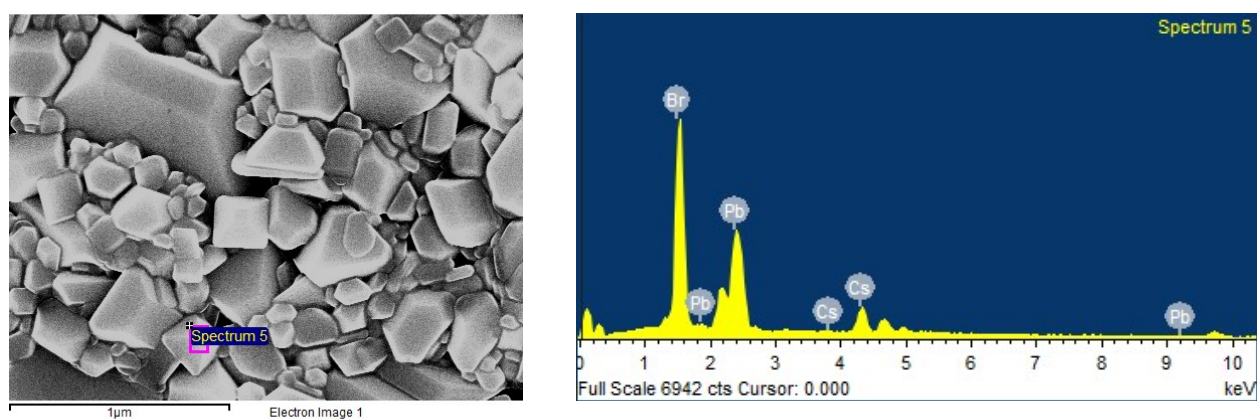


Figure S2. EDX spectra of CsPb₂Br₅

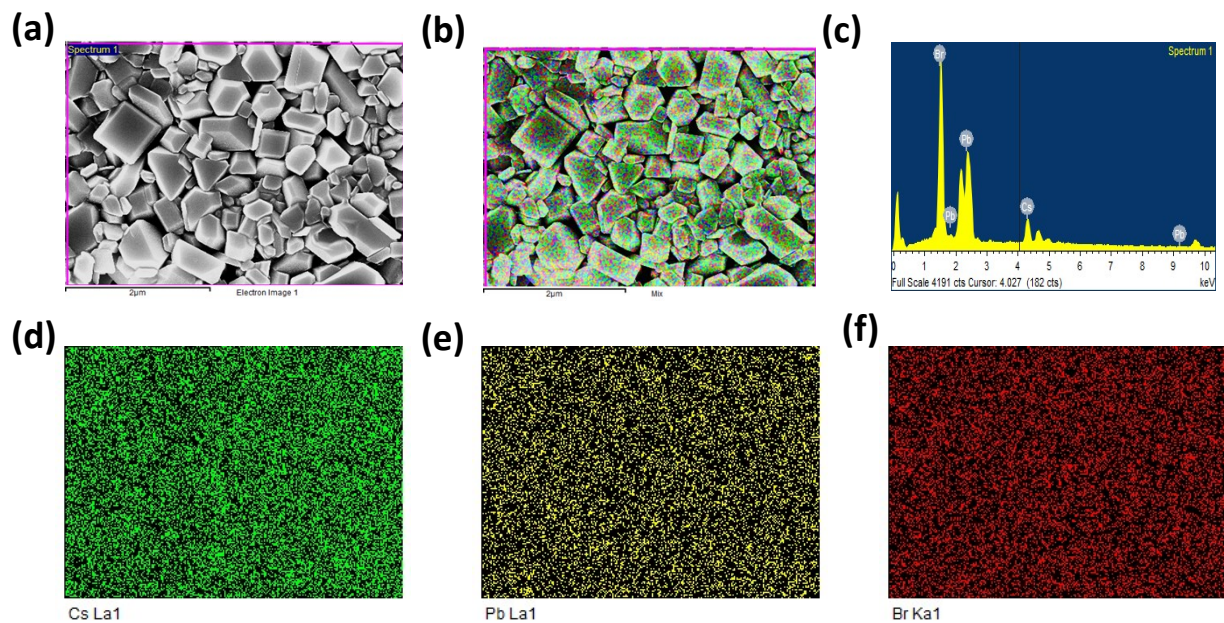


Figure S3 Elemental mapping of CsPb₂Br₅

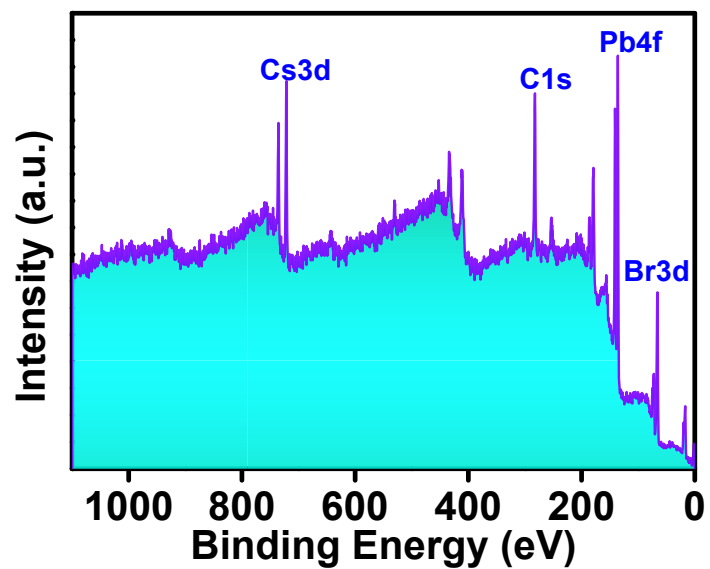


Figure S4. Survey scan of XPS for CsPb₂Br₅

Reference:

- 1) A. Suhail, A. Saini, S. Beniwal and M. Bag, *Journal of Physical Chemistry C*, 2023, **127**, 17298–17306.