Electronic Supplementary Material (ESI) for Materials Advances.

Supporting Information

2,2'-bipyridine-4,4'-dicarboxylic acid ligand engineered $CsPbBr_3$ perovskite nanocrystals for enhanced photoluminescence quantum yield with stable display application

Ankit Kumar[a], Sukanya Ghosh[a], Ankush Saini[b], Sumit Kumar[a], Monojit Bag *[b] Prasenjit Kar*[a]

[a]Department of Chemistry, Indian Institute of Technology Roorkee, Roorkee, Uttarakhand, India

[b]Department of Physics, Indian Institute of Technology Roorkee, Roorkee, Uttarakhand, India

E-mail: kar.prasen@gmail.com, prasenjit.kar@cy.iitr.ac.in, monojit.bag@ph.iitr.ac.in

Instrumentation details

1. Absorption and Emission (UV and PL) studies

Optical studies, i.e., absorption and emission spectra were recorded at room temperature. UV-vis absorption spectra were recorded on Shimadzu UV-vis 1800 spectrophotometer in the 200-800 nm range. Photoluminescence spectra were collected by using Cary Eclipse Fluorescence Spectrophotometer.

2. Fourier Transform Infrared Spectroscopy (FTIR) studies

Thermo Scientific Nicolet 6700 spectrometer was used to record FTIR spectra. The spectra were collected between 400 to 4000 cm^{-1} by using KBr pellet-making technique.

3. X-ray Diffraction (XRD)

Powder XRD was performed on Rigaku having a target Cu Kα with radiation of 1.54 Å and an accelerating voltage of 9 kW. The sample was scanned in the range of 10˚ to 50˚. The sample was prepared in the form of a thin film by using the drop-casting method on the silica glass slide.

4. Field Emission Scanning Electron Microscopy (FE-SEM)

FE-SEM Gemini 300 instrument was used to collect morphological images, Energy Dispersive X-ray (EDX), of corresponding elements. The drop-casting method was used to prepare a thin film of sample on a silica glass slide.

5. Transmission Electron Microscopy (TEM)

TEM study was performed on FEI TECHNAI G2 20 S-TWIN. A drop of diluted samples was deposited on a carbon-coated copper grid.

6. X-ray Photoelectron spectroscopy (XPS)

Surface analysis of the thin film has been studied on XPS with model no. PHI 5000 Versa Probe III.

7. Photoluminescence Quantum Yield (PLQY)

Absolute quantum yield was measured directly by using Edinburgh instruments FLS 980.

8. ^{1}H Nuclear magnetic resonance (^{1}H NMR)

^{1}H NMR spectra were recorded in DMSO d_6 on the Bruker instrument with model AVANCE III 500 MHz.

9. Time-correlated single-photon counting (TCSPC) studies

Fluorescence lifetime decay was measured by using Edinburgh instruments FLS 1000.

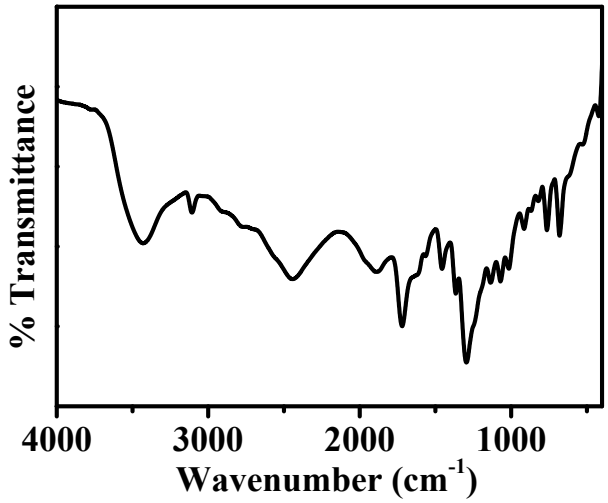

Figure S1. FTIR spectra of BPY.

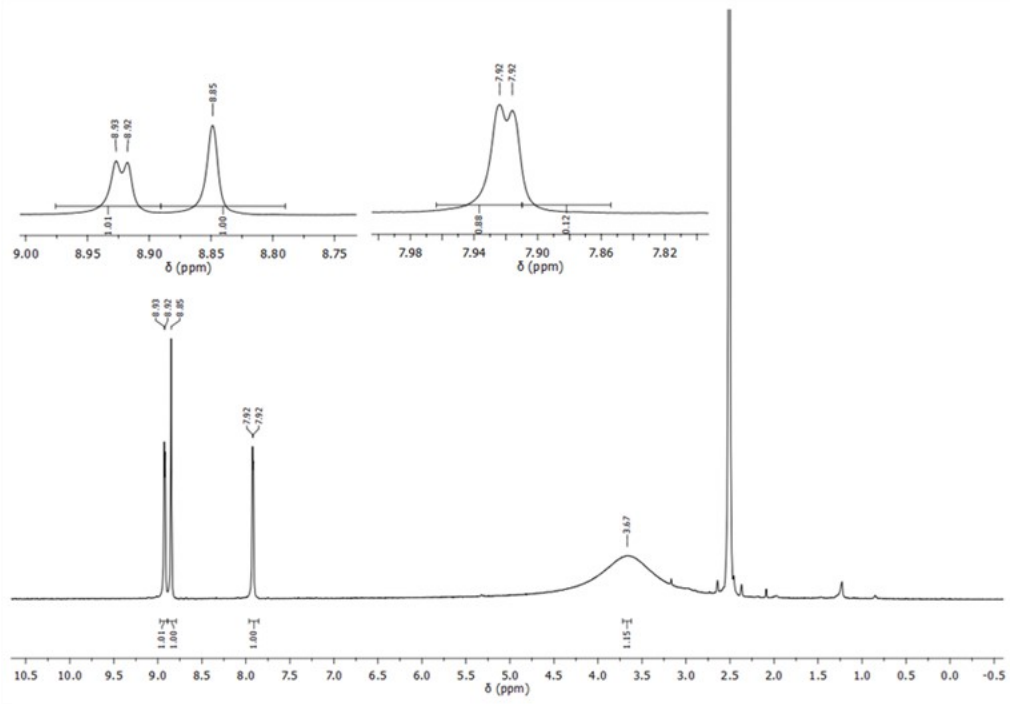

Figure S2. ^{1}H NMR spectrum of BPY.

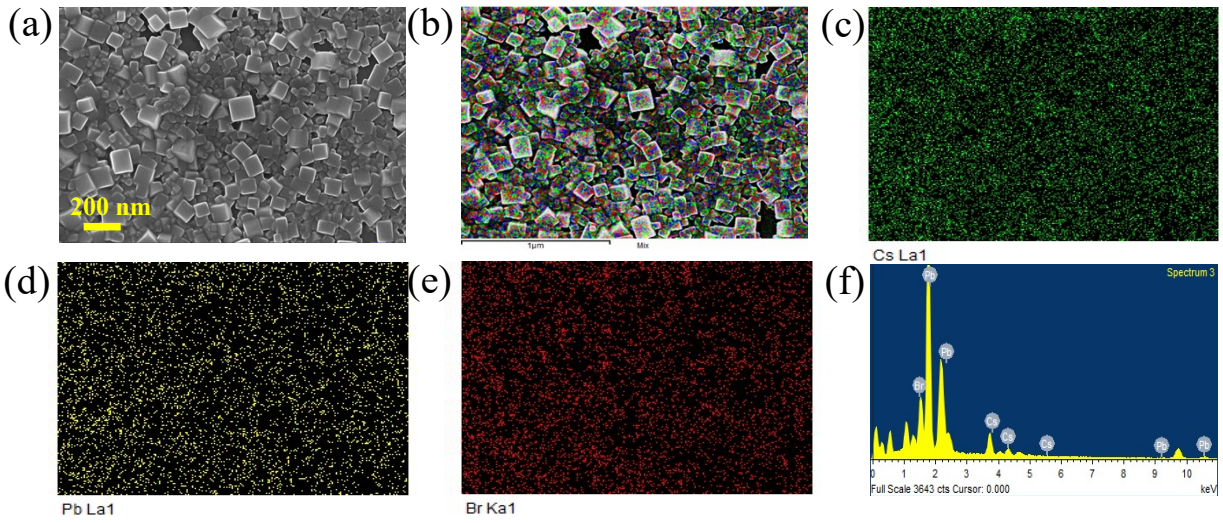

Figure S3. (a) SEM image; (b-e) elemental mapping; (f) EDX spectra of pristine $CsPbBr_3$ PNCs.

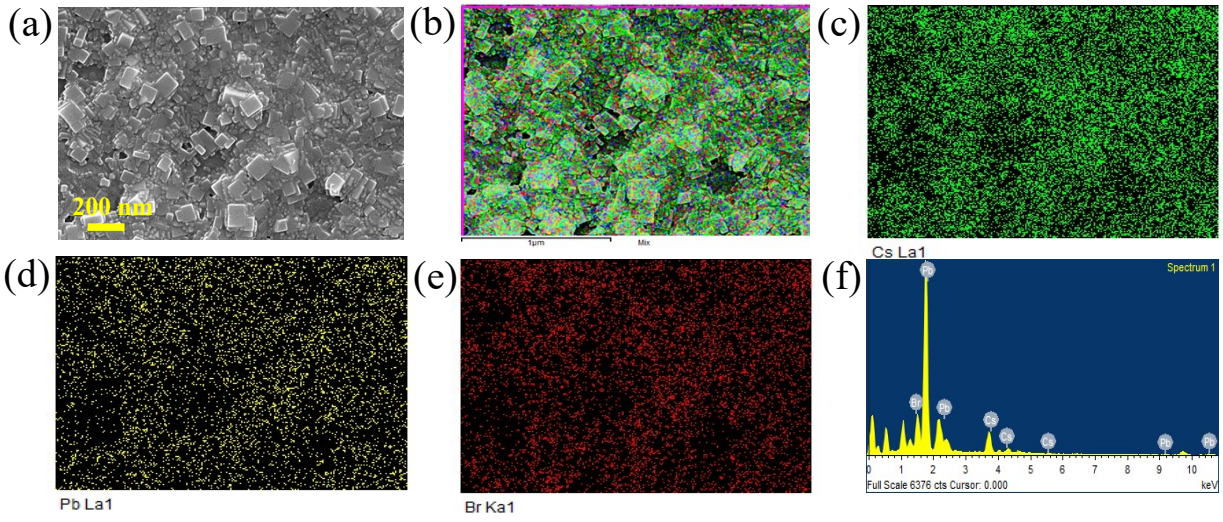

Figure S4. (a) SEM image; (b-e) elemental mapping; (f) EDX spectra of BPY-$CsPbBr_3$ PNCs.

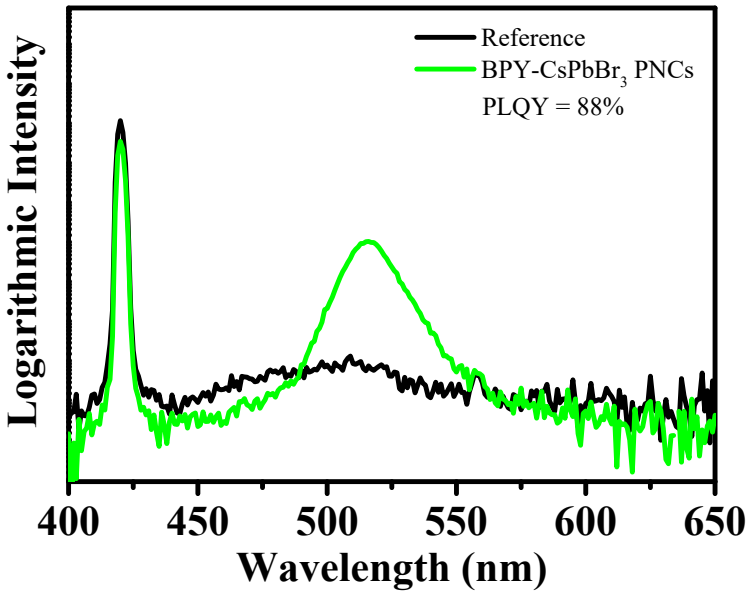

Figure S5. PLQY spectrum of BPY-$CsPbBr_3$ PNCs.

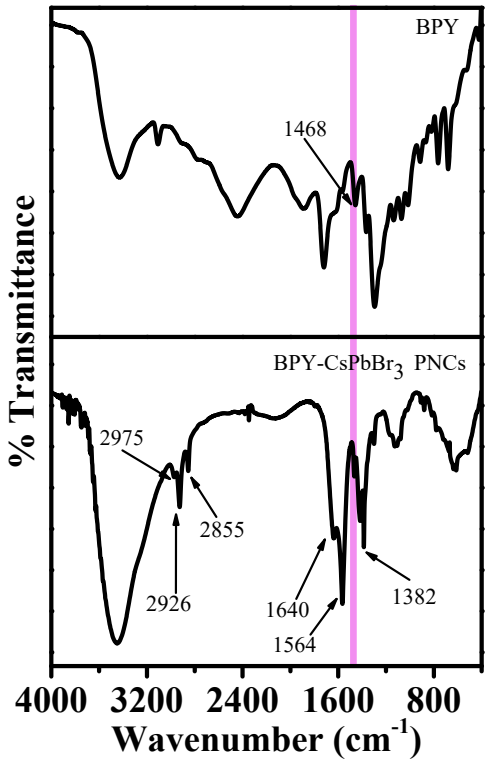

Figure S6. Combined FTIR spectra of BPY and BPY-$CsPbBr_3$ PNCs.

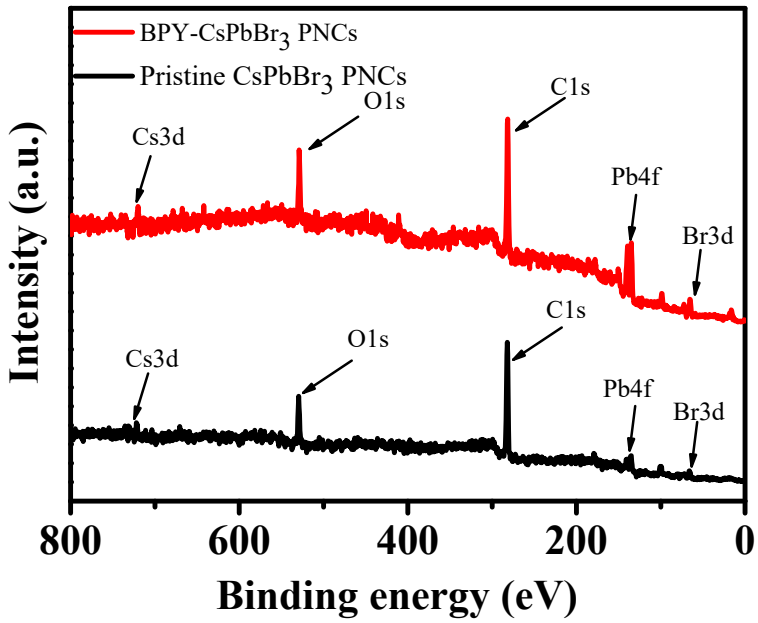

Figure S7. Survey spectrum of pristine $CsPbBr_3$ PNCs and BPY-$CsPbBr_3$ PNCs.

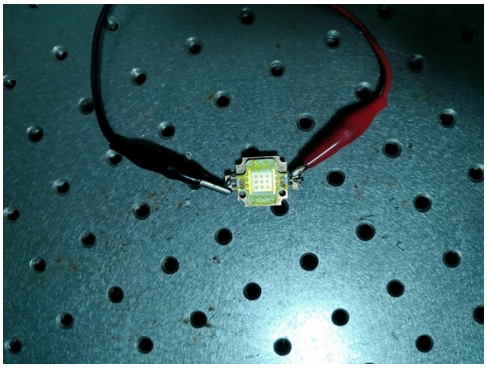

Figure S8. Photographs of down-converted LED under daylight.

Table S1. List of different bidentate ligands.

Sr. No.	Material used	Bidentate ligand used	PLQY (%)	PL stability	UV stability	Thermal stability	Reference No.
1.	$CsPbI_3$	IDA	95	15 days	_	_	1
2.	$CsPbCl_3$ $CsPbBr_3$ $CsPbI_3$	Phthalimide	5.8 100 97	4 months 1 year 1 week	2 days 2 days 2 days	_ _ _	2
3.	$CsPbBr_3$	DTDB	92	_	4.5 hr	80℃	3
4.	$CsPbBr_3$	Aminocaproic acid	59	_	_	_	4
5.	Mn-doped $CsPbCl_3$	BPY	70	1 month	24 hr	60℃	5
6.	$CsPbBr_3$	BPY	88	2 months	24 hr	60℃	This work