# Electronic Supplementary Information

## Poly acrylic acid-b-polystyrene -passivated $CsPbBr_3$ perovskite quantum dots with high photoluminescence quantum yield for light-emitting diodes

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**Supporting Experimental Section**

## Materials

Lead (II) bromide ($PbBr_2$, 99.9%), cesium bromide (CsBr, 99.999%), N, N-Dimethylformamide (DMF, > 99.8%), oleic acid (technical grade, 90%), and oleylamine (OAm, technical grade, 90%) were purchased from Aladdin Industrial Corporation, China. Hexane and toluene were purchased from Shanghai Titan Scientific Co., Ltd. All the reagents are directly used without further purification. Polyacrylic acid-b-polystyrene ($PAA_{24}$-b-$PS_{206}$ and$PAA_{24}$-b-$PS_{285}$) block copolymers were synthesized via sequential atomic transfer radical polymerization (ATRP) as previously reported[1,2].

**Synthesis of $CsPbBr_3$ PQDs and $CsPbBr_3$@PAA-b-PS PQDs**

The precursor solution was obtained by first dissolving $PbBr_2$ (0.4 mmol) and CsBr (0.4 mmol) in DMF (10 mL), followed by the adding of OAm (0.5 mL) and OA (1 mL) into the mixture. Then, it was stirred for half an hour to obtain a clear solution. After that, 0.25 mL precursor solution was quickly added into 5 mL toluene under vigorous stirring at 1500 rpm for 30 s to synthesize pure $CsPbBr_3$PQDs. $CsPbBr_3$@PAA-b-PS PQDs were synthesized by adding PAA-b-PS block polymer toluene solution into obtained fresh pure $CsPbBr_3$PQDs under vigorous stirring at 1500 rpm to achieve ligands exchange. A bright green solution could be immediately observed.

**Fabrication of white light-emitting diodes (WLEDs)**

The green $CsPbBr_3$@PAA-b-PS PQDs powder and $K_2SiF_6$:$Mn^{4+}$ phosphors were encapsulated into the epoxy resin adhesive. Then, the above mixture was put on the top of the red emissive layer. The optical properties of the fabricated white LED were evaluated by a temperature programed LED optoelectronic analyzer with an integrating sphere spectroradiometer system (Everfine, ATA-500, Hangzhou, China). The white LED was operated under a current of 20 mA.

## Supplementary Figures

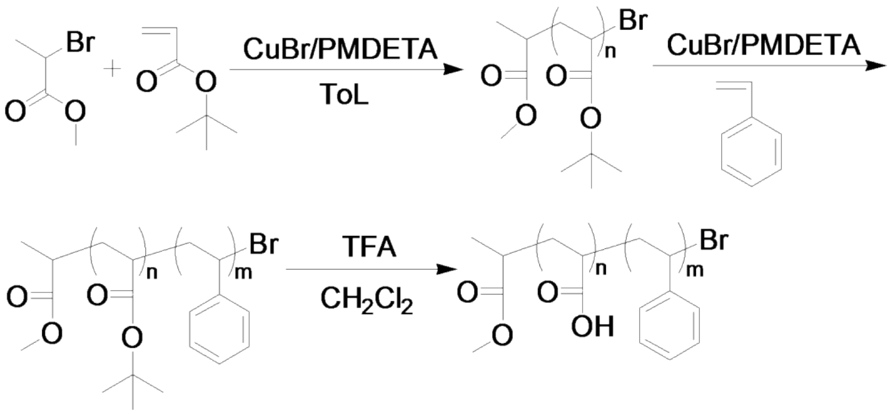


**Fig. S1.** Preparation of PAA-b-PS by sequential atom transfer radical polymerization (ATRP).

Polyacrylic acid-b-polystyrene ($PAA_{24}$-b-$PS_{206}$ and $PAA_{24}$-b-$PS_{285}$) block copolymers were synthesized via sequential atomic transfer radical polymerization (ATRP) as previously reported. Initially, tert-Butyl acrylate (tBA) was polymerized using CuBr complexed by N,N,N′,N″,N″-pentamethyldiethylenetriamine (PMDETA) as the catalyst and methyl 2-bromopropionate (MBP) as the initiator. Furthermore, styrene was polymerized using the same catalyst and PtBA as the macroinitiator. Finally, hydrolysis led to the corresponding PAA-b-PS.

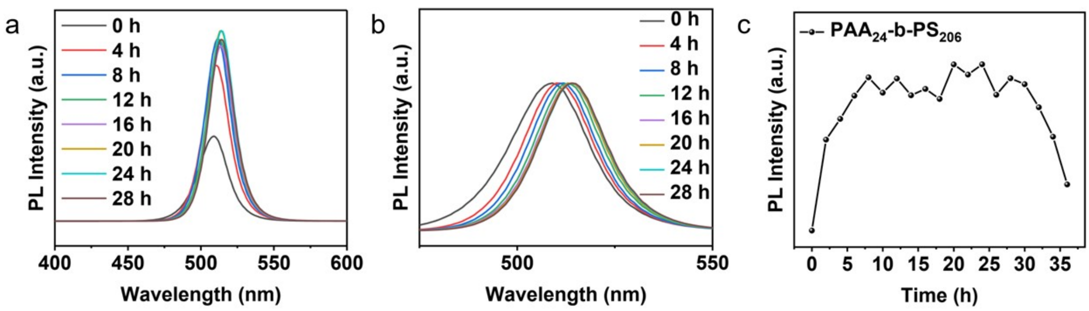


**Fig. S2.** (a) PL spectra of $CsPbBr_3$@$PAA_{24}$-b-$PS_{206}$ PQDs for different reaction times. (b) PL spectra of $CsPbBr_3$@$PAA_{24}$-b-$PS_{206}$ PQDs with different reaction times. (c) Variation of PL intensity with $CsPbBr_3$@$PAA_{24}$-b-$PS_{206}$ PQDs at different reaction times.

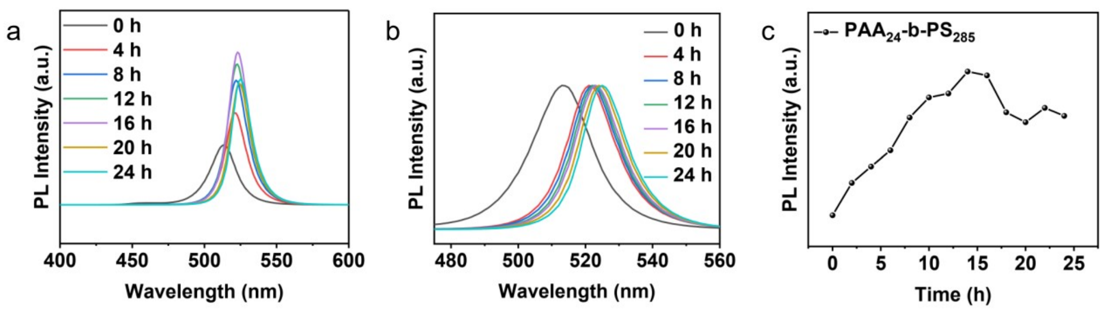


**Fig. S3.** (a) PL spectra of $CsPbBr_3$@$PAA_{24}$-b-$PS_{285}$ PQDs for different reaction times. (b) PL spectra of $CsPbBr_3$@$PAA_{24}$-b-$PS_{285}$ PQDs with different reaction times. (c) Variation of PL intensity with $CsPbBr_3$@$PAA_{24}$-b-$PS_{285}$ PQDs at different reaction times.

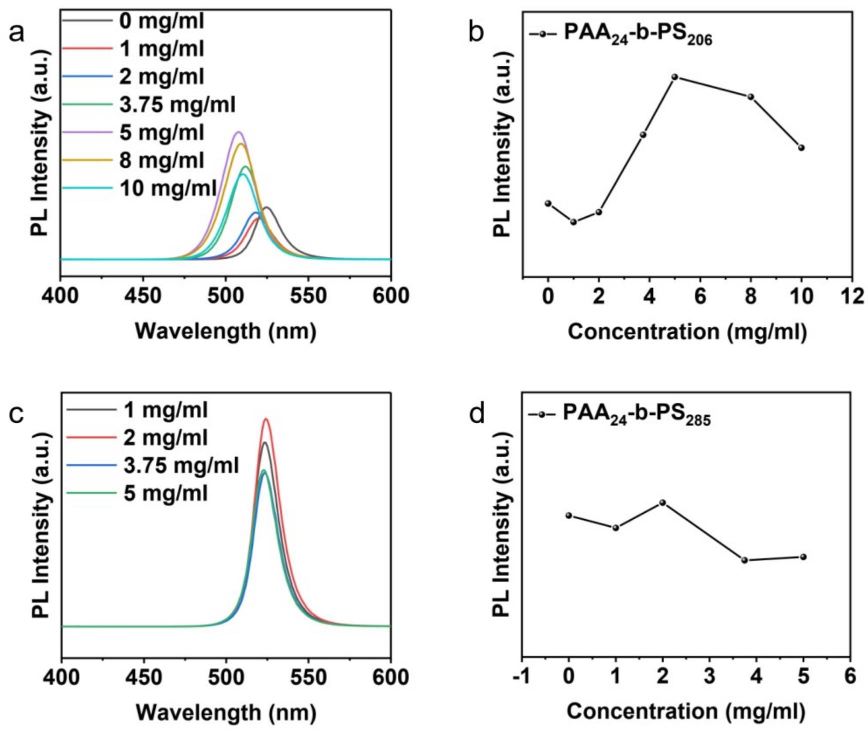


**Fig. S4.** (a) PL spectra of $CsPbBr_3$@$PAA_{24}$-b-$PS_{206}$ PQDs with different concentrations. (b) Variation of PL intensity with $CsPbBr_3$@$PAA_{24}$-b-$PS_{206}$ PQDs concentrations. (c) PL spectra of $CsPbBr_3$@$PAA_{24}$-b-$PS_{285}$ PQDs with different concentrations. (d) Variation of PL intensity with $CsPbBr_3$@$PAA_{24}$-b-$PS_{285}$ PQDs concentrations.

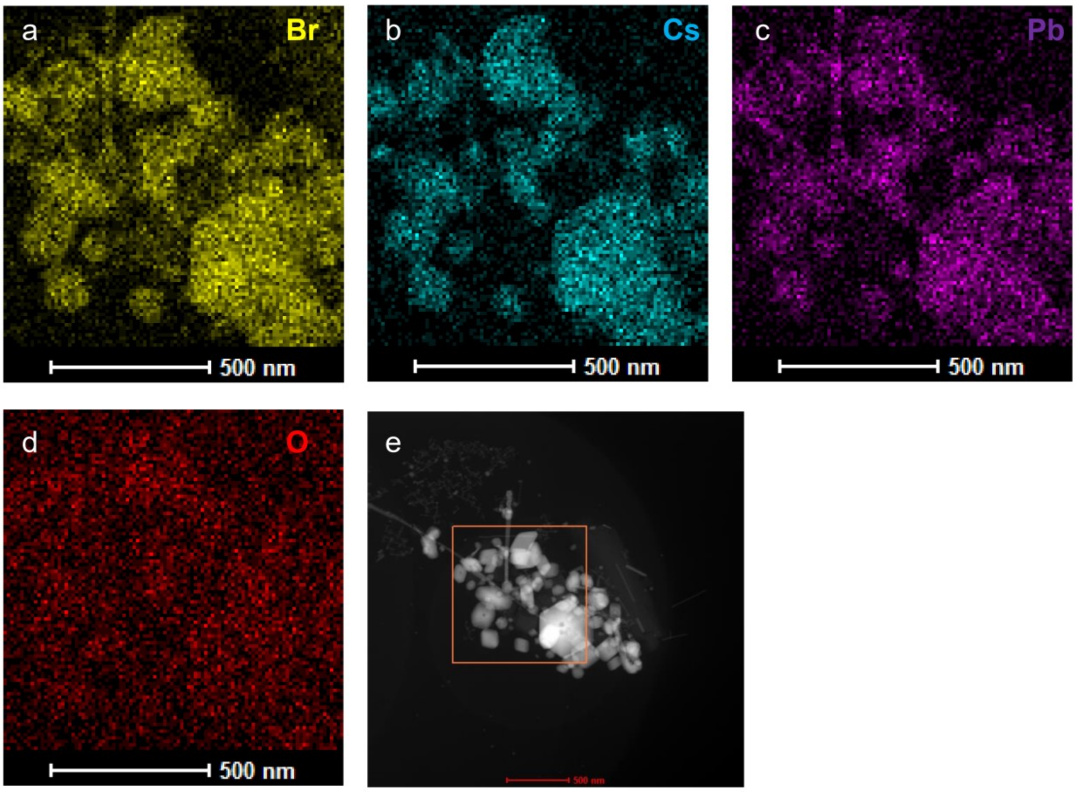


**Fig. S5.** EDX elemental mappings of (a) Br (yellow), (b) Cs (blue), (c) Pb (purple), and (d) O (red). (e) High-angle annular dark-field scanning TEM.

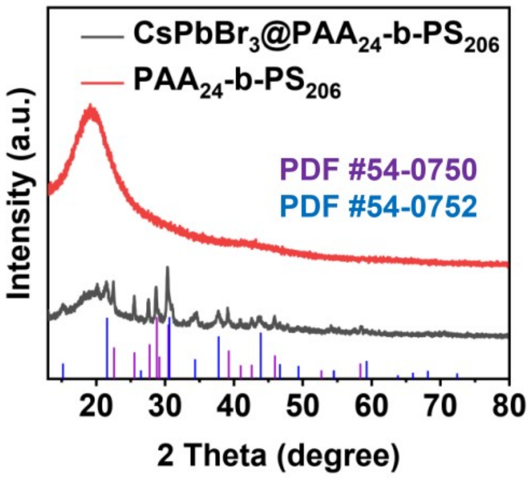


**Fig. S6.** XRD patterns of $CsPbBr_3$@$PAA_{24}$-b-$PS_{206}$ PQDs (black line) and $PAA_{24}$-b-$PS_{206}$ (red line).

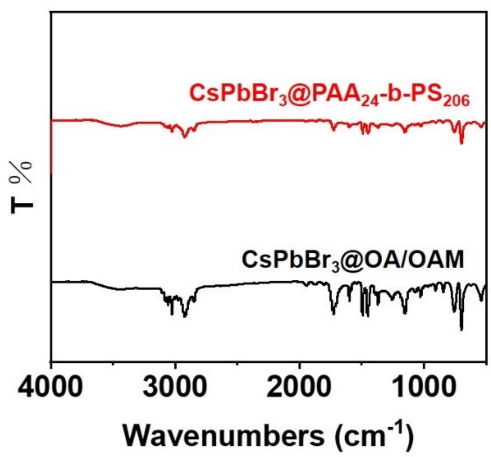


**Fig. S7.** FTIR images of $CsPbBr_3$@$PAA_{24}$-b-$PS_{206}$ PQDs (red line) and $CsPbBr_3$@OA/OAM PQDs (black line) after reaction for 24 hours.

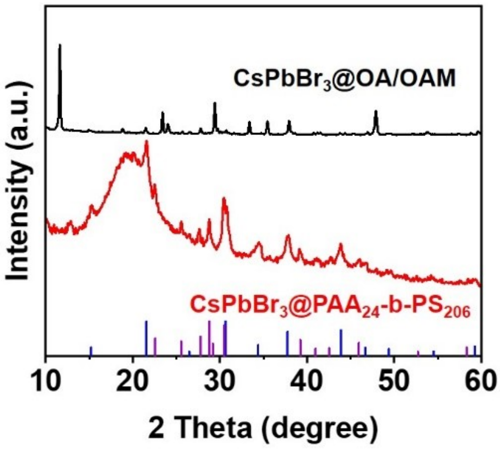


**Fig. S8.** XRD patterns of $CsPbBr_3$@$PAA_{24}$-b-$PS_{206}$ PQDs (red line) and pristine $CsPbBr_3$ PQDs (black line) after immersion in ethanol for 2 days.

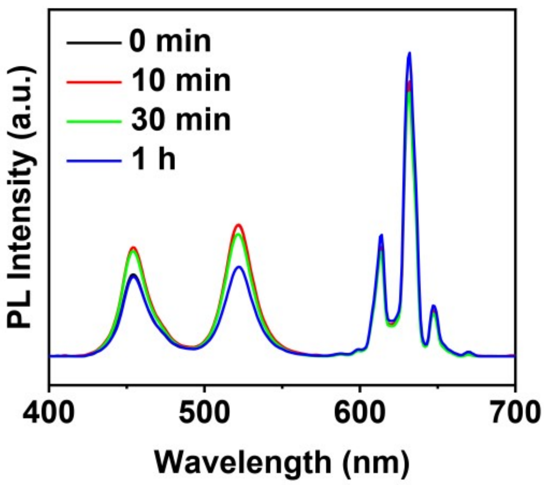


**Fig. S9.** White light-emitting diodes (WLEDs) PL images with different light times.

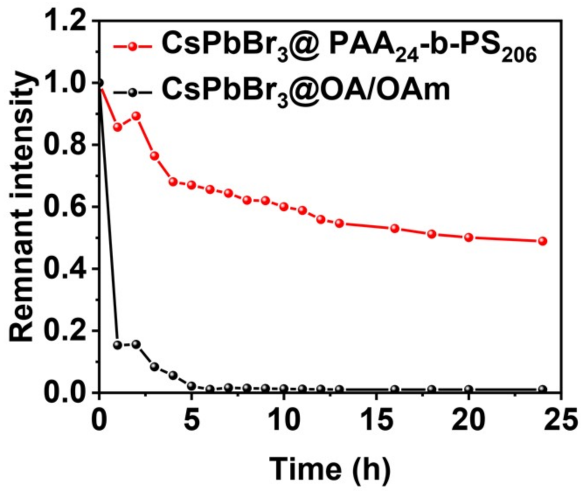


**Fig. S10.** Remnant PL values of $CsPbBr_3$@OA/OAM and $CsPbBr_3$@$PAA_{24}$-b-$PS_{206}$ PQDs in water.

**Table S1.** Polymers and PQDs used in PQDs/polymer nanocomposites.

| Polymer/monomer | | PQDs | PLQY (%) | Ref. |
|---|---|---|---|---|
| Poly acrylic acid-b-polystyrene | PAA-b-PS | $CsPbBr_3$ | 95 | This work |
| Polystyrene | PS | $CsPbX_3$ | 75 | [3] |
| | | | 44 | [4] |
| | | | 25 | [5] |
| | | | 68 | [6] |
| | | | 34 | [7] |
| | | | 48 | [8] |
| | | | 27 | [9] |
| | | | 79 | [10] |
| Poly (ethylene glycol) | PEG | $CsPbX_3$ | 41 | [11] |
| Poly (ethylene oxide) | PEO | $CsPbBr_3$ | 60 | [12] |
| Poly (vinylidene fluoride) | PVDF | $CsPbBr_3$ | 65 | [13] |
| Poly (methyl methacrylate) | PMMA | $CsPbX_3$ | 54 | [14] |
| | | | 45 | [15] |
| Poly (lauryl methacrylate) | PLMA | $CsPbBr_3$ | 86 | [16] |
| Poly(vinylpyrrolidone) | PVP | $CsPbX_3$ | 55 | [17] |
| | | | 24 | [18] |
| Poly (lactic acid) | PLA | $CsPbX_3$ | 90 | [19] |
| Poly (maleic | PMAO | $CsPbX_3$ | 88 | [20] |
| anhydride-*alt*-1-octadecene) | | | 69 | [21] |
| | | | 88.8 | [22] |
| Poly (isobutylene-*alt*-maleic anhydride) | PIMA | $CsPbBr_3$ | 80 | [23] |
| Ethyl cellulose | | $CsPbBr_3$ | 37.2 | [24] |
| Diphenylvinylphosphine-styrene copolymer | PDPEP-*co*-PS | $CsPbBr_3$ | 90 | [25] |
| Polystyrene-*block*-poly-2-vinylpyridine | PS-*b*-P2VP | $CsPbX_3$ | 51 | [26] |
| Poly (divinylbenzene) | PDVB | $CsPbBr_3$ | 60 | [27] |
| Poly (ethylene vinyl acetate) | PEVA | $CsPbBr_3$ | 40.5 | [28] |
| Star-like poly(acrylic | PAA-*b*-PS | $CsPbBr_3$ | 91.4 | [29] |
| acid)-*block*-polystyrene | | | 71 | [30] |
| Star-like polystyrene-*block*-poly (acrylic acid)-*block*-polystyrene | PS-*b*-PAA-*b*-PS | $CsPbBr_3$ | 67 | [30] |
| Poly (ethylenimine) | PEI | $CsPbBr_3$ | 75 | [31] |
| | | | 85 | [32] |
| Polyimide | PI | $CsPbBr_3$ | 88.1 | [33] |
| Poly (2-(dimethylamino) ethylmethacrylate) | PDMAEMA | $CsPbBr_3$ | 60 | [34] |

**Table S2**. Comparisons with the $CsPbBr_3$ QDs-based WLEDs reported previously.

| Samples | PLQY (%) | CCT (K) | CRI | CIE coordinates (X, Y) | Ref. |
|---|---|---|---|---|---|
| $CsPbBr_3$@$PAA_{24}$-b-$PS_{206}$+ $K_2SiF_6:Mn^{4+}$(KSF) phosphors | 95 | 5464 | 65.5 | (0.3333, 0.3396) | This work |
| $CsPbBr_3$@$ZrO_2$ + $CaAlSiN_3:Eu^{2+}$ | 80 | 4743 | NA | (0.351, 0.346) | [35] |
| $CsPbBr_3$@$SiO_2$ + Ag-In-Zn-S | 75 | 3689 | 91 | (0.4037, 0.411) | [36] |
| $CsPbBr_3$: Na + KSF phosphors | 85 | 6652 | 75.2 | (0.31, 0.33), | [37] |
| $CsPbBr_3$/PMAO + nitride phosphors | 88.8 | 3320 | NA | (0.390, 0.332) | [38] |
| $CsPbBr_3$ + KSF phosphors | 93 | 4574 | 85 | (0.34, 0.31) | [39] |
| $CsPbBr_3$ AeroPQDs + KSF phosphor | 75.6 | 6500 | NA | (0.31, 0.33) | [40] |

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