Electronic Supplementary Material (ESI) for Chemical Communications.

Supporting Information

Synthesis of Perovskite $CsPbBr_3$ Quantum Dot Superlattice in Borosilicate Glass

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Experimental Section

Materials and chemicals

Silicon dioxide (SiO_2, 99.99%), boron oxide (B_2O_3, 98%), zinc oxide (ZnO, 99%), caesium carbonate (Cs_2CO_3, 99%), lead bromide ($PbBr_2$, 99%) and sodium bromide (NaBr, 99%) were purchased from Aladdin. All chemicals were used without further purification.

Preparation of $CsPbBr_3$ QDs glass

The samples of pristine glass (PG) were prepared via classical melt-quenching method with nominal composition of $(35.7\text{-}3.5x)SiO_2\text{-}(24.5\text{+}3.5x)B_2O_3\text{-}9.8ZnO\text{-}6Cs_2CO_3\text{-}12PbBr_2\text{-}12NaBr$ (mol.%) ($x = 1, 2, 3$, denoted PG1, PG2, PG3, respectively). The raw materials were well mixed and melted at 1150°C for 20 min under ambient atmosphere. Then the melt of mixture was poured onto a preheated brass plate and pressed by another plate. The glasses of PG1, PG2 and PG3 were annealed at 360°C for 2 h, and were then heated at 475°C for 2 h to obtain $CsPbBr_3$ QDs and/or $CsPbBr_3$ QD superlattices embedded glasses (denoted QG1, QG2, QG3, respectively).

Characterizations

The $CsPbBr_3$ QDs and/or $CsPbBr_3$ QD superlattices embedded glasses were optical polished or ground into powders for subsequent characterization and usage. X-ray diffraction (XRD) analysis was carried out to identify the crystallized phase structure using a Bruker D8 powder diffractometer with a Cu Kα incident radiation source. Microstructural observation of samples was conducted on a JEOL JEM-2100 transmission electron microscope (TEM). Absorption spectra were recorded using a Hitachi U4100 spectrophotometer. Photoluminescence (PL) and photoluminescence excitation (PLE), excitation-emission mapping, and PL decay were recorded using an Edinburgh FLS980 spectrophotometer. Raman spectra were determined by a LabRAM HR Evolution Raman spectrometer operated with a 532 nm excitation source.

As shown in Fig. S1, we obtain a primrose transparent $CsPbBr_3$ QD embedded glass at 475°C while other glasses are either colorless at 435°C or devitrificated at 515°C, 555°C and 595°C.

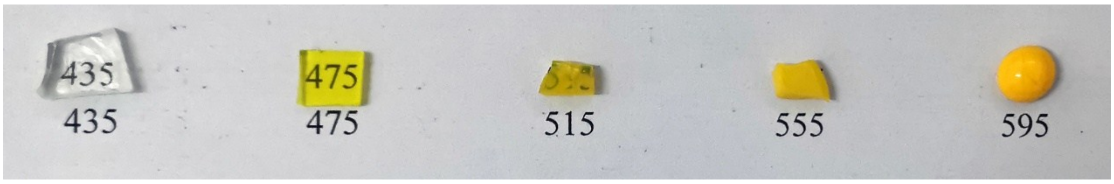

Fig. S1 The photograph of PG1 glass heated under different temperatures (435°C, 475°C, 515°C, 555°C and 595°C) for 2 h.

Table S1 The quantitative change of topological organization from Raman spectra

glass	$[BO_3]/[BO_4]$	$[BO_3]/[SiO_4]$	$[BO_4]/[SiO_4]$
PG1	1.22	0.81	0.66
PG2	1.25	0.85	0.68
PG3	1.64	1.13	0.68

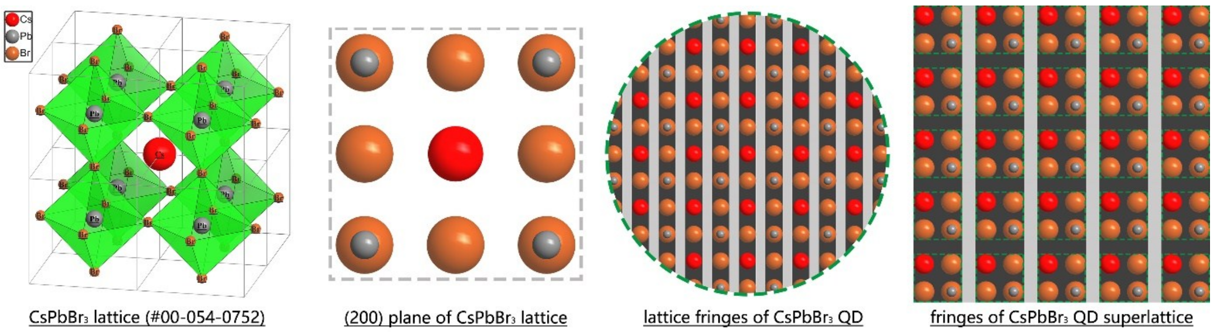

Fig. S2 Schematic illustration. (a) $CsPbBr_3$ lattice. (b) (200) plane of $CsPbBr_3$ lattice. (c) lattice fringes of $CsPbBr_3$ QD. (d) fringes of $CsPbBr_3$ QD superlattice.

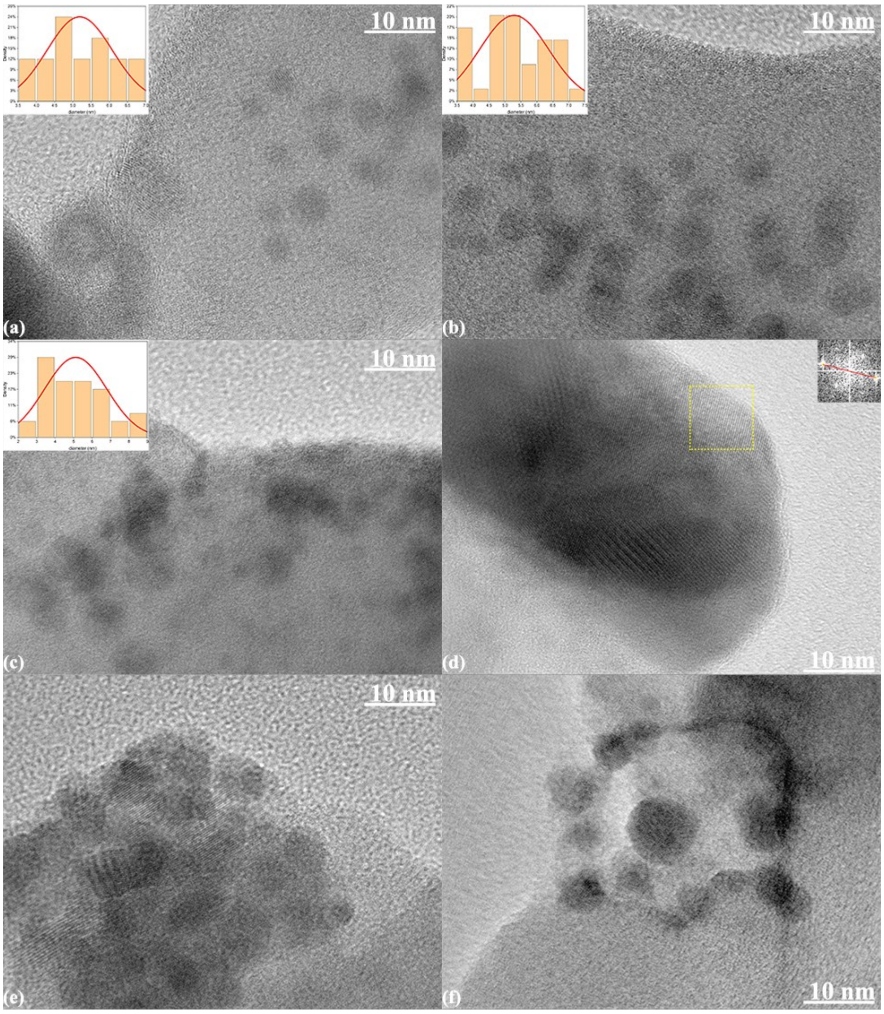

Fig. S3 TEM images of $CsPbBr_3$ morphology. (a)-(c) distribution of $CsPbBr_3$ QDs in QG1, QG2, QG3. (d) $CsPbBr_3$ QD superlattice lattice. (e)-(f) aggregation of $CsPbBr_3$ QDs.

Table S2 The average size of $CsPbBr_3$ QD

glass	QG1	QG2	QG3
average size (nm)	5.2	5.3	5.1

We measured their corresponding radiation lifetimes under different power density excitation as shown in Fig. S4. And the average decay lifetime are calculated based on the following equation S(1)

$$\tau_{ave} = \int I(t)dt/I_0 \quad S(1)$$

where I_0 is the peak intensity and $I(t)$ is the recording-time related PL intensity.

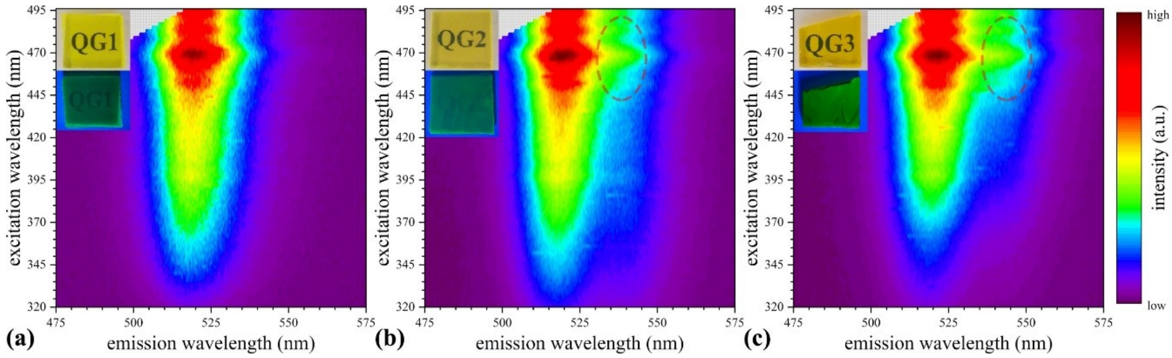

Fig. S4 Two-dimensional excitation-emission mappings of (a) QG1, (b) QG2, (c) QG3, and the inset shows the photograph of $CsPbBr_3$ QDs embedded glasses under daylight and 365 nm UV lamp.

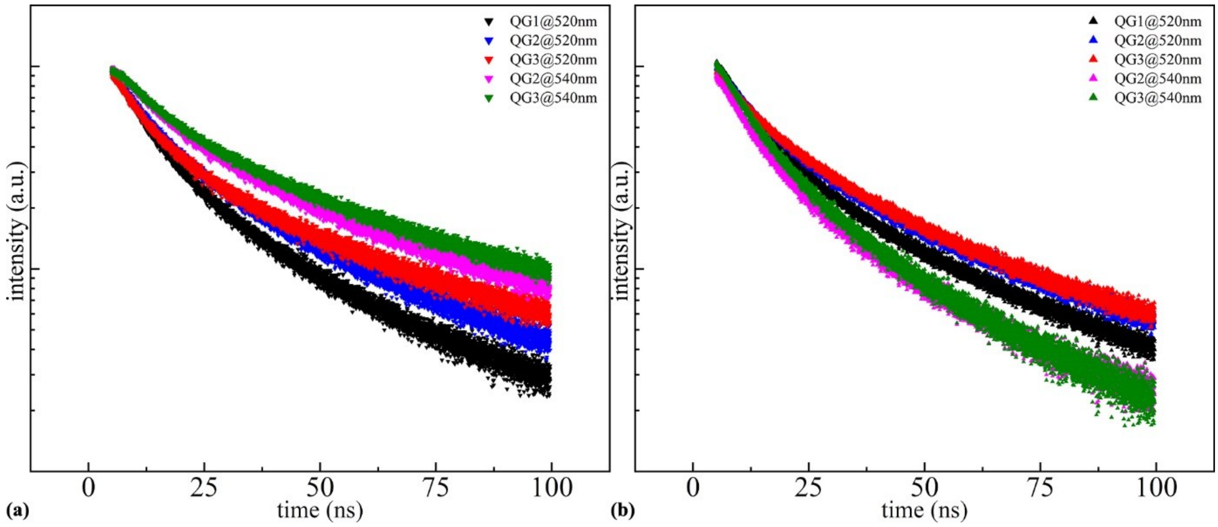

Fig. S5 Time-resolved PL decays curves under (a) low power density excitation and (b) high power density excitation.

Table S3 The lifetimes under different power density excitation

PL decays curves	QG1 @520nm	QG2 @520nm	QG3 @520nm	QG2 @540nm	QG3 @540nm
τ_{ave} (ns) under low power density excitation	15.87	18.93	19.78	25.74	27.84
τ_{ave} (ns) under high power density excitation	19.29	21.57	21.99	14.65	16.37