Supporting Information

CsPbBr$_3$: xEu^{3+}perovskiteQDs borosilicate glass: a new member to the family of luminescent materials.

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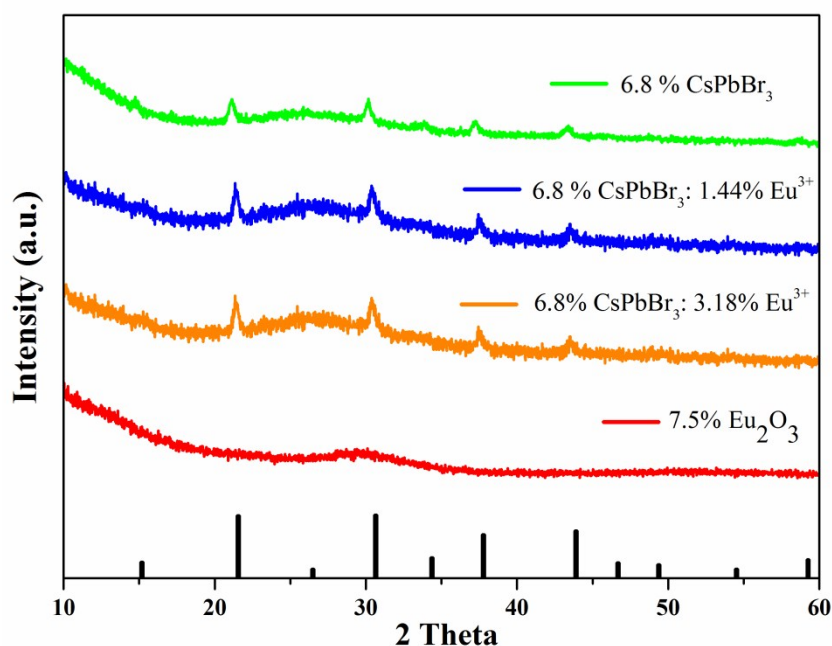
Figure S1. XRD pattern of CsPbBr$_3$:x Eu^{3+} glass sample. The diffraction peaks of the CsPbBr$_3$:x Eu^{3+} QDs glasses with 2-theta value located in approximately 21.86°, 30.81°, 37.92°, 44.11°, which are corresponding to the (110), (200), (211), (220) planes of cubic phase of CsPbBr$_3$ (JCPDS No. 54-0752).
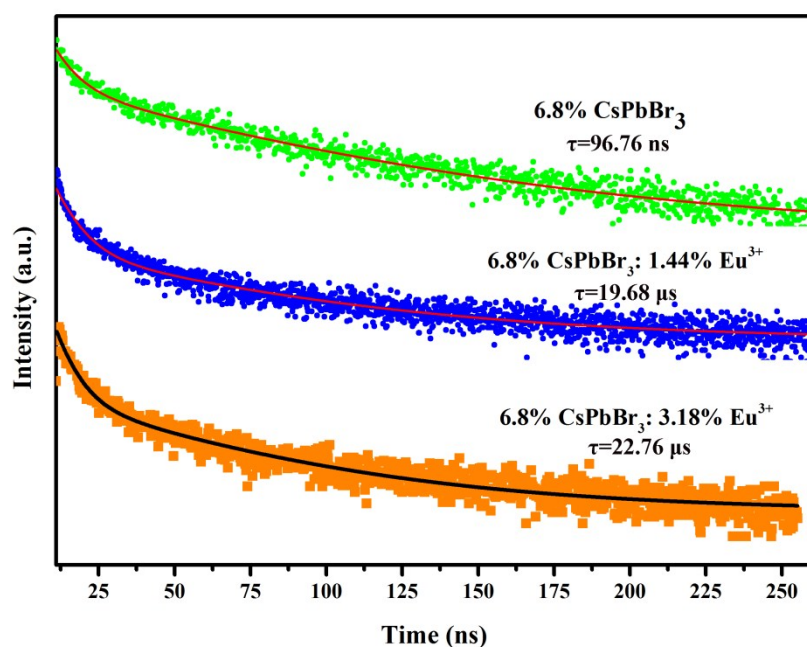

Figure S2. PL decay curves of the perovskite CsPbBr$_3$:xEu^{3+} QDs glasses with different Eu^{3+} ions concentrations measured using 365 nm excitation.
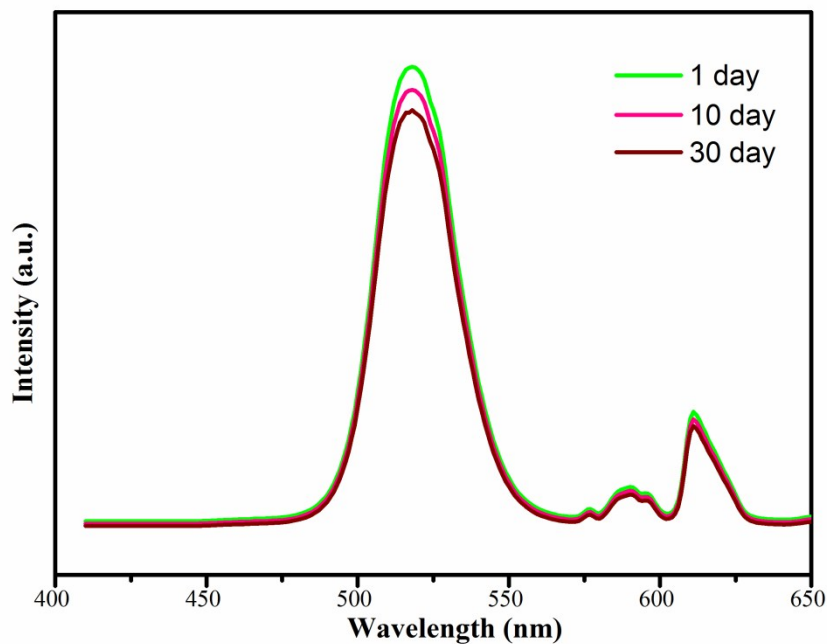
Fig S3. PL spectra of $6.8\%CsPbBr_3:1.44\%Eu^{3+}$ QDsglass after different time.

Table S1 Absolute PLQY of overall region for $CsPbBr_3$ QDs with different concentrations

sample	PLQY
1.7%CsPbBr3	**84.5%**
3.4%CsPbBr3	**41.9%**
6.8%CsPbBr3	**35.2%**
9.5%CsPbBr3	**20%**

Table S2.The theoretical and actual concentrations of Pb^{2+} and Eu^{3+} ions when $CsPbBr_3:xEu^{3+}$ glasses dissolved in a liter of revant.

Samples	Theoretical concentrations		Actual concentrations	
	$C_{Pb2+}{}'$	$C_{Eu3+}{}'$	C_{Pb2+}	C_{Eu3+}
$6.8\%CsPbBr_3:1.44\%Eu^{3+}$	0.177 g/L	0.072 g/L	0.163 g/L	0.067 g/L
$6.8\%CsPbBr_3:3.18\%Eu^{3+}$	0.503 g/L	0.156 g/L	0.451 g/L	0.134 g/L

ICP was used to measure the actual doping concentrations of Eu^{3+} in the solid $CsPbBr_3$ crystals by measuring the PL the concentration of Eu^{3+} left in the filtrate, 20mg glass powder were dissolved in 20ml HF then deionized water were added in volumetric flask to dilute solution(diluted in1000 times). The theoretical and and actual concentrations of Pb^{2+} and Eu^{3+} ions were list in Table S2. By simple calculation, the theoretical concentrations of Pb^{2+} and Eu^{3+} of $6.8\%CsPbBr_3:1.44\%Eu^{3+}$ glass are 0.177 g/L and 0.072 g/L, the actual concentrations of Pb^{2+} and Eu^{3+} of $6.8\%CsPbBr_3:1.44\%Eu^{3+}$ glass are 0.163 g/L and 0.067 g/L; The theoretical concentrations of Pb^{2+} and Eu^{3+} of $6.8\%CsPbBr_3:3.18\%Eu^{3+}$ glass are 0.503g/L and 0.156 g/L, the actual concentrations of Pb^{2+} and Eu^{3+} of $6.8\%CsPbBr_3:1.44\%Eu^{3+}$ glass are0.451 g/L and 0.134 g/L. There is little difference between the theoretical concentrations and the actual concentrations, mainly due to a small amount of substances volatilized in high temperature and some unavoild inaccuracy thoughtout the whole process, such as weighting and transferring operations.

Table S3. Biexponential Fit valves of the perovskite $CsPbBr_3$:x Eu^{3+} QDs glass with different Eu^{3+} ions concentrations measured using 400 nm excitan.

sample	T_1 （ns)	T_2(ns)	A_1	A_2	τ (ns)
6.8%CsPbBr$_3$	9.74	96.76	0.0914	1058	96.76
6.8%CsPbBr$_3$:1.44% Eu^{3+}	1.62	19681.93	0.0001	238845810	19682
6.8%CsPbBr$_3$:3.18% Eu^{3+}	37.33	22755.46	0.0016	13890476	22755

Fitting accurately to the sum of double-exponential.

$$\tau = \frac{\sum_i \left(A_i T_i^2\right)}{\sum_i \left(A_i T_i\right)} \qquad (A_1 = \frac{T1}{T1+T2} \quad A_2 = \frac{T2}{T1+T2})$$

Table S4. Absolute PLQY of overall region for $CsPbBr_3$:$x$$Eu^{3+}$ QDs glass with different Eu^{3+} ions concentrations

sample	PLQY
6.8%CsPbBr$_3$	35.2%
6.8%CsPbBr$_3$:1.44% Eu^{3+}	59.2%
6.8%CsPbBr$_3$:3.18% Eu^{3+}	73.5%

Table S5 Optical parameters of the as-constructed LED with different Eu^{3+} ions concentrations

sample	CRI	Red (%)	Green (%)	Blue (%)	Peak (nm)	Color coordinates	excitation purity	CCT(K)
6.8%CsPbBr$_3$	11	0.3	99.2	0.5	508.3	(0.1534, 0.7517)	47.18	9413
6.8%CsPbBr$_3$: 1.44%Eu^{3+}	22.4	4.9	95	0.1	550.5	(0.3050, 0.6302)	96.0	5924
6.8%CsPbBr$_3$: 3.18%Eu^{3+}	42.8	41.8	55.7	2.5	595.2	(0.4103, 0.4215)	50.48	2403
5.05%Eu$_2$O$_3$	29.8	67.7	30.9	1.3	700	(0.5298, 0.2737)	43.78	1186