Highly Uniform Thinly-Wrapped CsPbX$_3$@Silicone Nanocrystals via Self Hydrolysis: Suppressed Anion Exchange and Superior Stability in Polar Solvents

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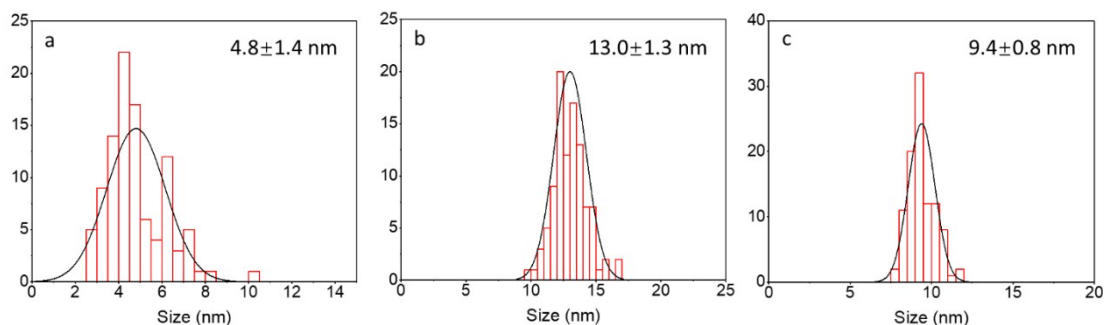
Fig. S1 Size distribution of (a) CsPbBr$_3$-silicone matrix composite, (b) CsPbBr$_3$@silicone and (c) conventional OAm-CsPbBr$_3$ nanocrystals.
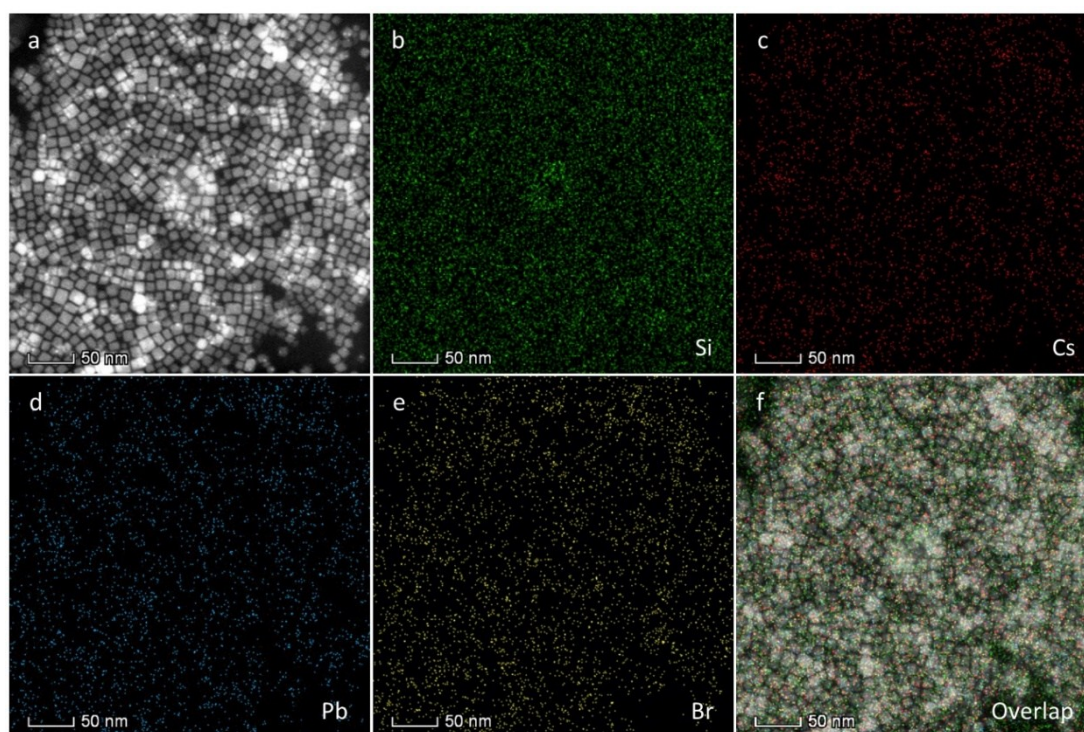

Fig. S2 (a) HAADF-TEM image and elemental mapping images of CsPbBr$_3$@silicone showing the elemental distribution of (b) Si (green), (c) Cs (red), (d) Pb (light blue), (e) Br (light yellow) and (f) overlapped image.
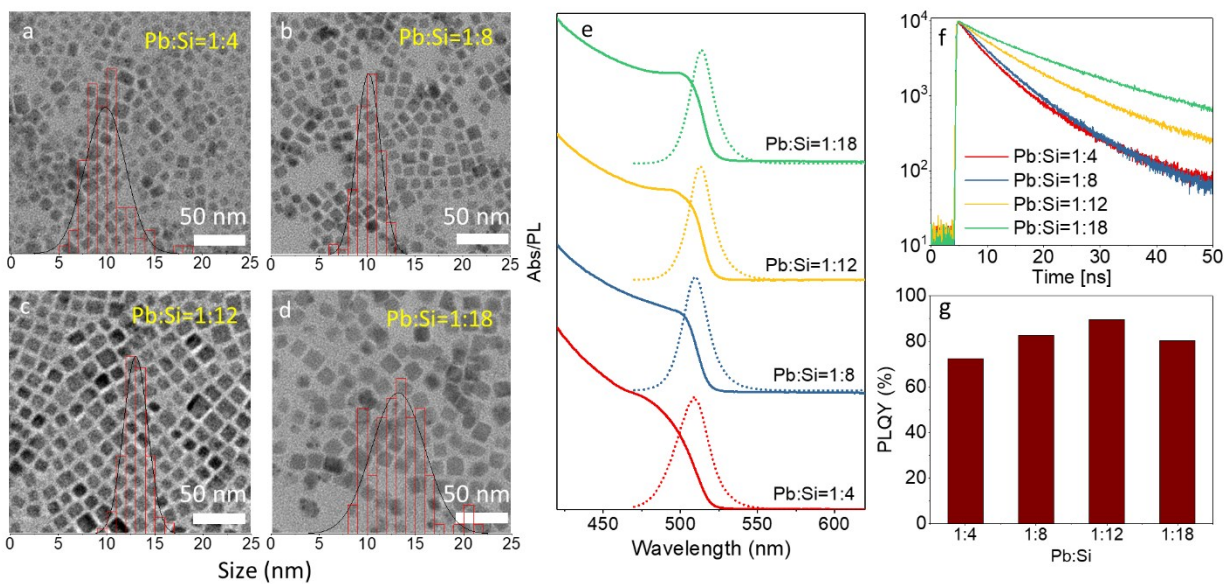
Fig. S3 Characterization of CsPbBr$_3$@silicone nanocrystals synthesized with increasing mole ratio of PbBr$_2$: APTES from1:4 to 1:18: (a)-(d) TEM and corresponding size distribution, (e) UV-Vis and PL spectra, (f) PL decay and (g) PL QY.

Measurements of Electron Extraction Rates. Time-resolved PL decay were fitted to

$$A(t) = A_1 \exp\left(-\frac{\tau}{\tau_1}\right) + A_2 \exp\left(-\frac{\tau}{\tau_2}\right) + A_3 \exp\left(-\frac{\tau}{\tau_3}\right). \quad (1)$$

The average lifetimes were calculated using the intensity-weighted model as

$$\tau = (A_1\tau_1^2 + A_2\tau_2^2 + A_3\tau_3^2)/(A_1\tau_1 + A_2\tau_2 + A_3\tau_3). \quad (2)$$

The electron extraction rate k can be obtained using the following equation:

$$k = \frac{1}{\tau_{ET}} = \frac{1}{\tau_{ave,\ TiO_2}} - \frac{1}{\tau_{ave,\ PMMA}}. \quad (3)$$

And all results are summarized in Table S1.

		τ_1 (ns)	A_1	τ_2 (ns)	A_2	τ_3 (ns)	A_3	τ_{ave} (ns)	k (ns^{-1})
OAm-CsPbBr$_3$	TiO$_2$	19.02	101	5.44	4999	2.67	6989	4.90	0.053
	PMMA	14.96	516	5.61	11479	-	-	6.61	
CsPbBr$_3$@ silicone	TiO$_2$	35.76	1069	13.48	5969	3.33	4706	18.63	0.013
	PMMA	45.75	1230	16.80	6387	4.10	4505	24.46	
OAm-CsPbI$_3$	TiO$_2$	33.06	624	10.66	6652	2.27	4281	14.42	0.006
	PMMA	17.11	3262	41.59	334	9.66	7414	15.74	
CsPbI$_3$@ silicone	TiO$_2$	103.33	1714	46.06	6253	15.83	4256	61.29	0.003

PMMA	129.00	1533	56.13	5916	19.92	4354	74.41

Table S1 The fitting results of PL decay for thinly-wrapped CsPbBr$_3$@silicone (CsPbI$_3$@silicone) and OAm-CsPbBr$_3$ (OAm-CsPbI$_3$) nanocrystals coated on PMMA and TiO$_2$ films, respectively.
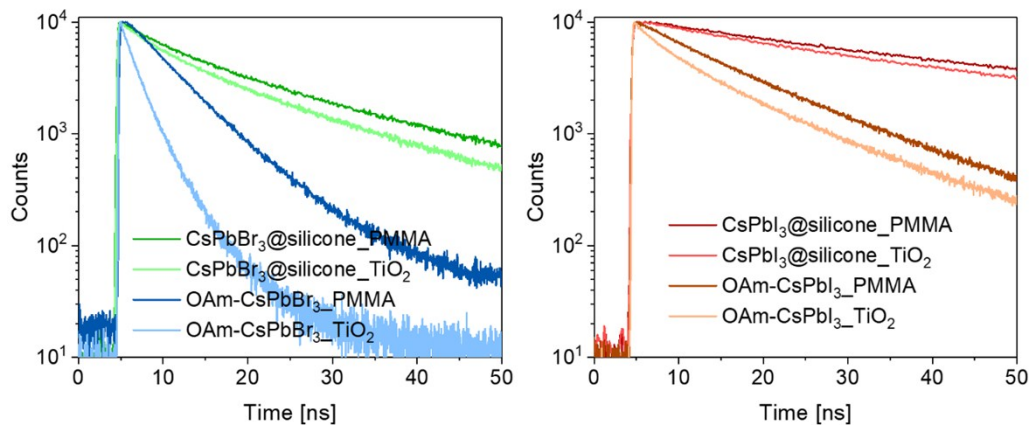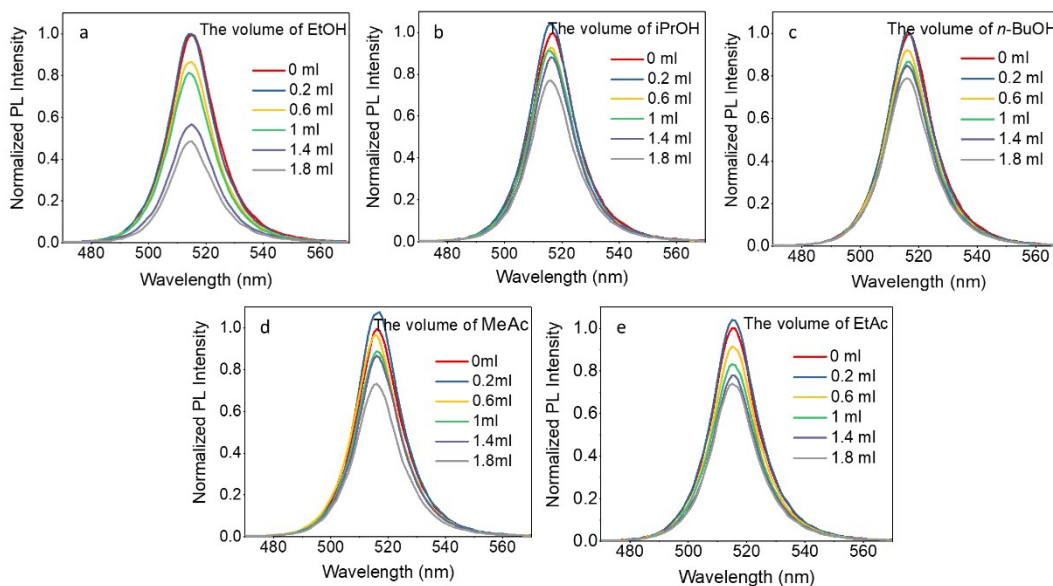
Fig. S4 PL decay of CsPbBr$_3$@silicone (CsPbI$_3$@silicone) and OAm-CsPbBr$_3$(OAm-CsPbI$_3$) nanocrystals coated on PMMA and TiO$_2$ films, respectively.

Fig. S5 PL peak emission intensities of CsPbBr$_3$@silicone in octane with different polar solvent of different volume ratios: (a) ethanol (EtOH), (b) isopropyl alcohol (iPrOH), (c) *n*-Butyl alcohol (*n*-BuOH), (d) methyl acetate (MeAc) and (e) ethyl acetate (EtAc).
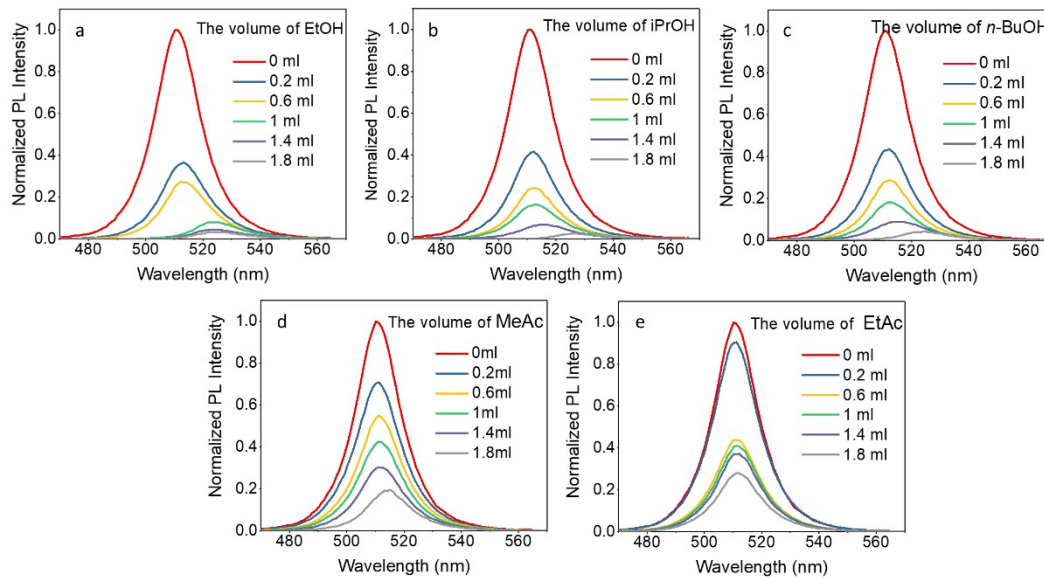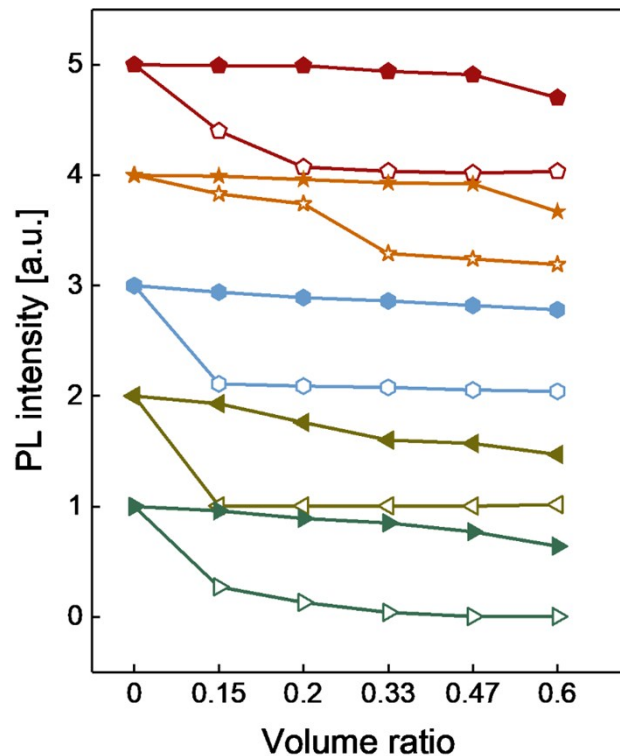

Fig. S6 PL peak emission intensities of OAm-CsPbBr$_3$ in octane with different polar solvent of different volume ratios: (a) ethanol (EtOH), (b) isopropyl alcohol (iPrOH), (c) *n*-Butyl alcohol (*n*-BuOH), (d) methyl acetate (MeAc) and (e) ethyl acetate (EtAc).

Fig. S7. PL emission peak intensities of CsPbI$_3$@silicone (solid symbols) and OAm-CsPbI$_3$ (hollow symbols) in octane with different polar solvents of varying volume ratios (from top to bottom: EtOH, iPrOH, *n*-BuOH, MeAc and EtAc).
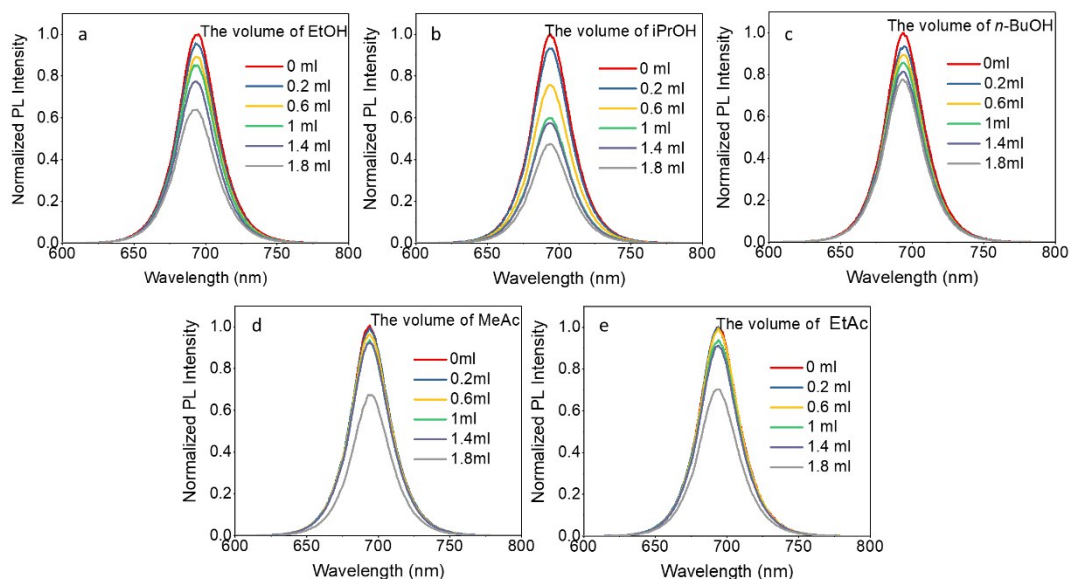
Fig. S8 PL peak emission intensities of CsPbI$_3$@Silicone in octane with different polar solvent of different volume ratios: (a) ethanol (EtOH), (b) isopropyl alcohol (iPrOH), (c) *n*-Butyl alcohol (*n*-BuOH), (d) methyl acetate (MeAc) and (e) ethyl acetate (EtAc).
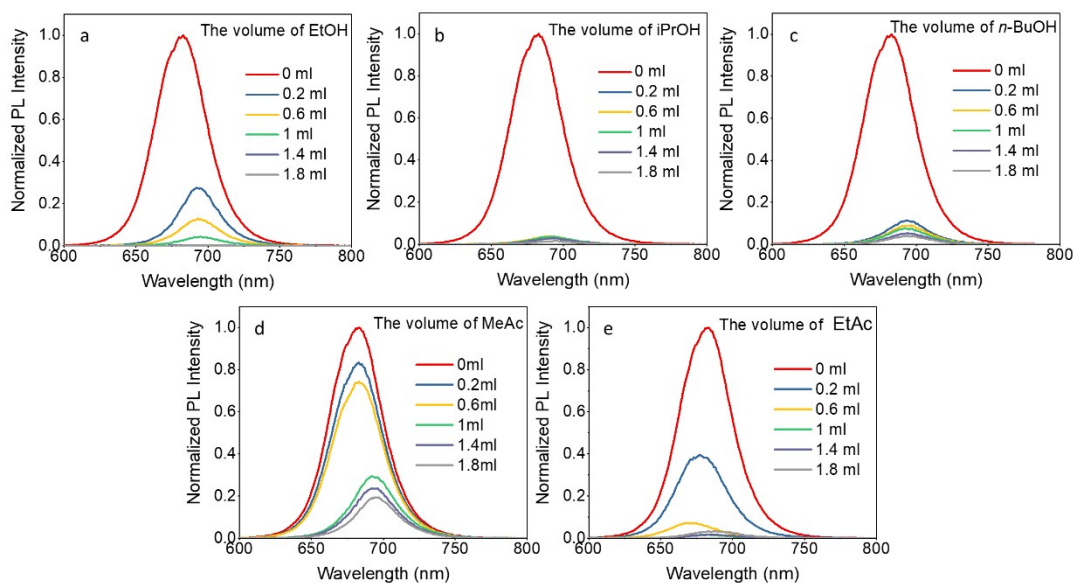

Fig. S9 PL peak emission intensities of OAm-CsPbI$_3$ in octane with different polar solvent of different volume ratios: (a) ethanol (EtOH), (b) isopropyl alcohol (iPrOH), (c) *n*-Butyl alcohol (*n*-BuOH), (d) methyl acetate (MeAc) and (e) ethyl acetate (EtAc).
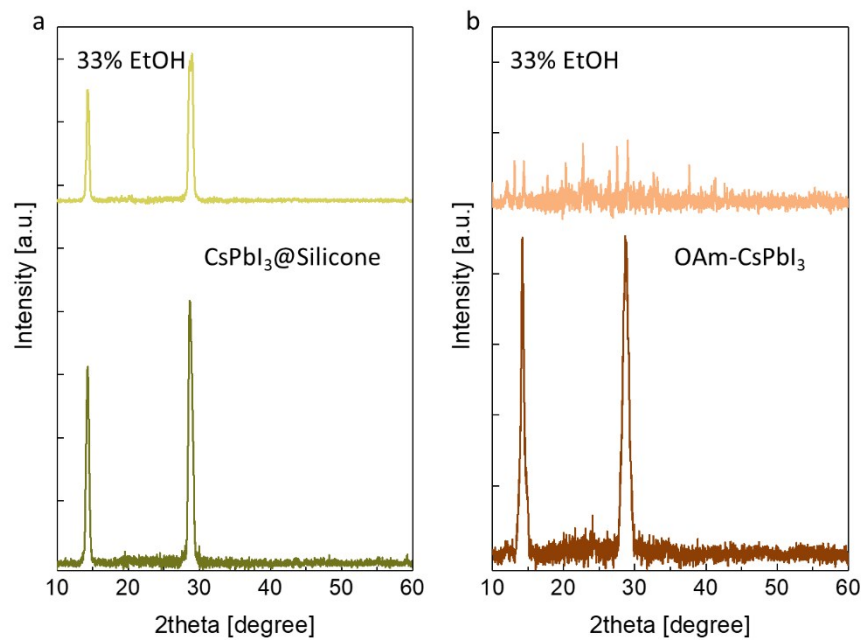
Fig. S10 XRD patterns measured before (bottom curves) and after (top curves) the addition of 33% ethanol in (a) CsPbI$_3$@silicone and (b) OAm-CsPbI$_3$ nanocrystals.
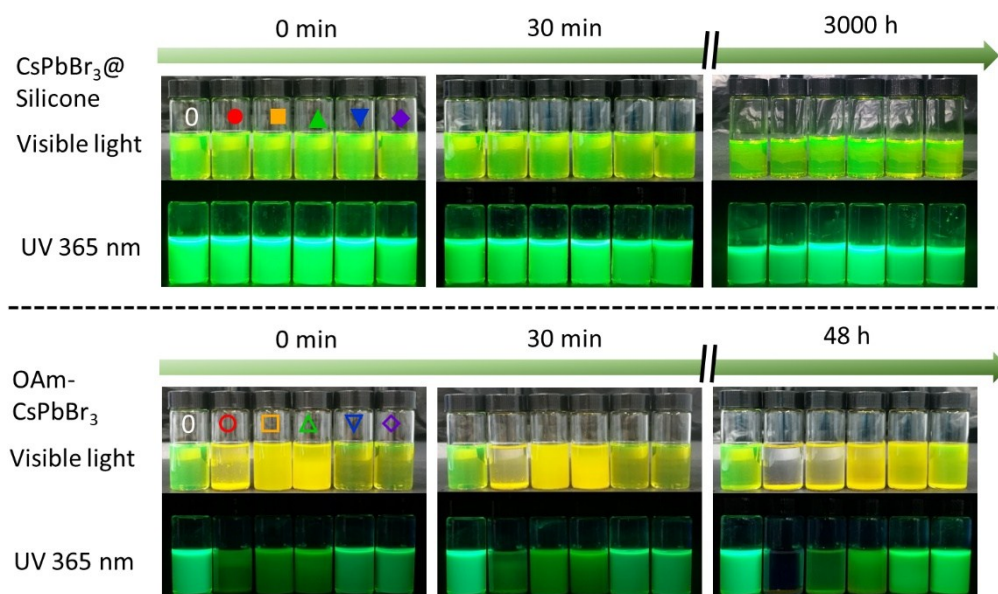
Fig. S11 Photos of CsPbBr$_3$@silicone and OAm-CsPbBr$_3$ nanocrystals in different polar solvents (33%) in natural light and UV 365 nm. (from left to right: octane, EtOH, iPrOH, *n*-BuOH, MeAc and EtAc, CsPbBr$_3$@silicone (solid symbols) and OAm-CsPbBr$_3$ (hollow symbols)).
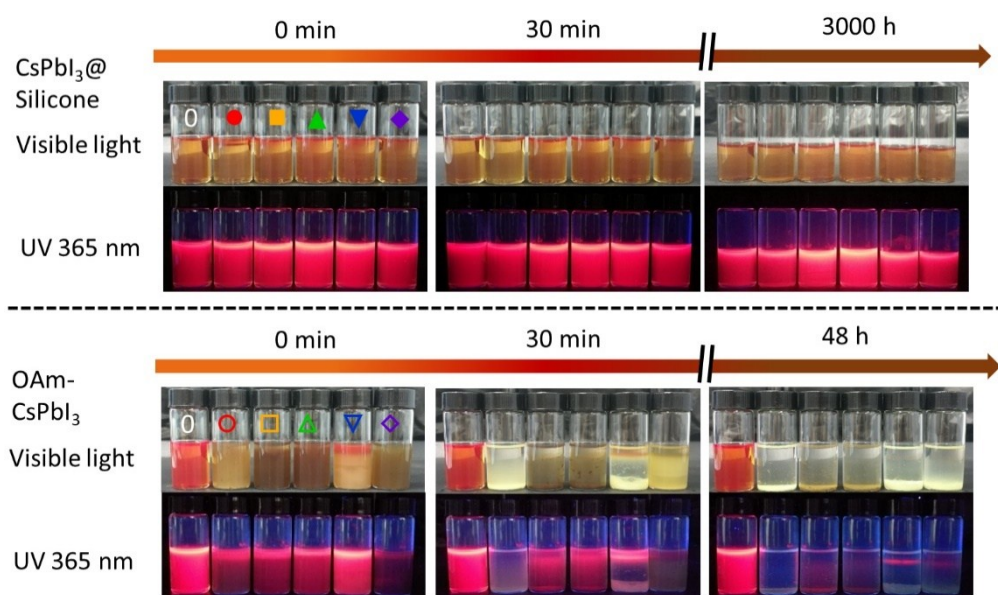

Fig. S12 Photos of CsPbI$_3$@silicone and OAm-CsPbI$_3$ nanocrystals in different polar solvents (33%) in natural light and UV 365 nm. (from left to right: octane, EtOH, iPrOH, *n*-BuOH, MeAc and EtAc, CsPbI$_3$@silicone (solid symbols) and OAm-CsPbI$_3$ (hollow symbols)).
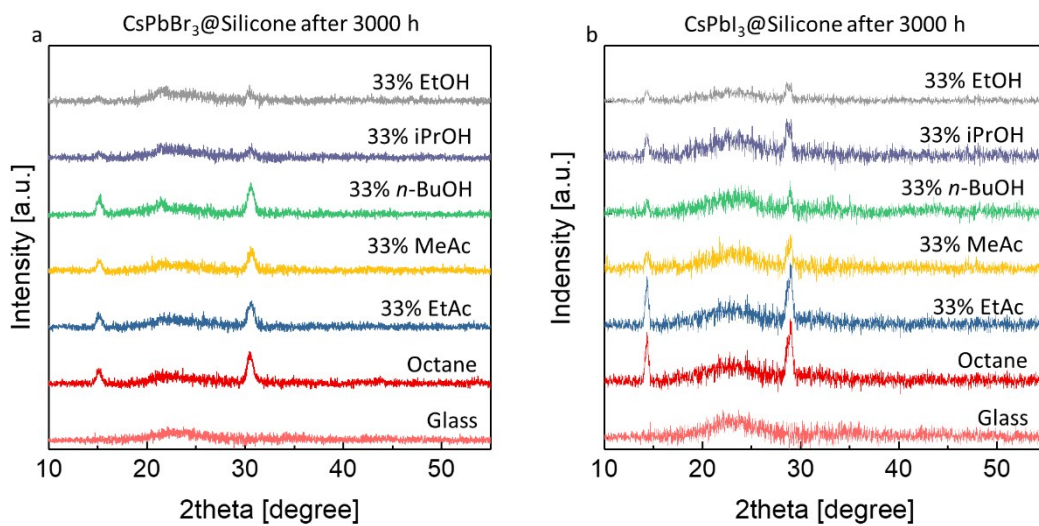
Fig. S13 XRD patterns measured in octane with different polar solvents of 33% volume ratios after 3000 h for (a) CsPbBr$_3$@silicone and (b) CsPbI$_3$@silicone nanocrystals.
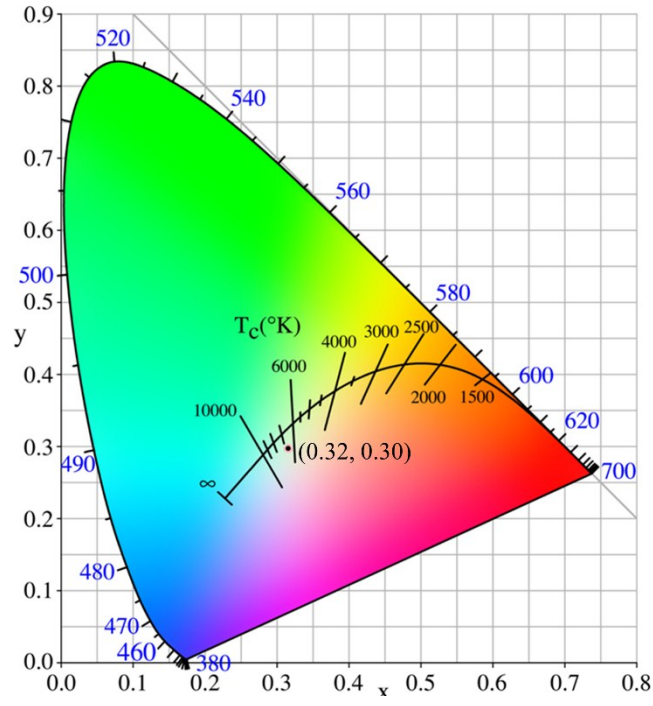
Fig. S14 CIE color coordinates of the WLED device.