

## Supporting information

### **Ultra-stable narrowband green emitting CsPbBr<sub>3</sub> quantum dots embedded glass ceramics for wide color gamut backlit display**

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**Table S1.** The spectral data of CsPbBr<sub>3</sub>@glass prepared by different one-step heat-treatment temperatures and times.

Heat-treatment condition (°C)	Emission peak (nm)	PLQY (%)	FWHM (nm)	Decay (ns)
460/6h	519	37	25.46	47.80
480/2h	520	40.43	25.74	49.87
500/2h	521	52.85	27.70	65.87
520/0.5h	520	51.98	26.10	35.35
540/0.5h	519	54.68	26.76	37.84
560/10min	520	53.68	26.35	34.53
580/3min	514	50.69	28.74	20.97
600/5min	521	51.18	25.81	43.64

**Table S2.** The spectral data of CsPbBr<sub>3</sub>@glass prepared by two-step heat treatment (600 °C high-temperature rapid nucleation and 460 °C low-temperature slow growth) at different times.

Heat treatment condition (°C)	Emission peak (nm)	PLQY (%)	FWHM (nm)	Decay (ns)
600/15min-460/1h	515	60.25	26.24	22.95
600/30min-460/1h	524	36.88	22.28	109.4
600/1h-460/1h	525	16.24	22.98	165.43
600/30min-460/15min	523	25.05	24.53	98.97
600/30min-460/30min	524	25.17	22.54	105.29
600/30min-460/1h	524	36.88	22.28	109.4
600/30min-460/2h	525	22.99	22.84	114.37
600/30min-460/4h	524	26.76	23.43	105.25

**Table S3.** The spectral data of CsPbBr<sub>3</sub>@glass prepared by two-step heat treatment (460 °C low-temperature slow nucleation and 600 °C high-temperature rapid growth) at different times.

Heat treatment temperature (°C)	Emission peak (nm)	PLQY (%)	FWHM (nm)	Decay (ns)
460/1h-600/15min	514	54.97	27.31	21.90
460/1h-600/30min	523	35.11	23.07	98.93
460/1h-600/1h	525	20.44	23.05	149.12
460/15min-600/30min	524	27.41	23.19	107.48
460/30min-600/30min	524	24.75	22.92	104.88
460/1h-600/30min	523	35.11	23.07	98.93
460/2h-600/30min	525	23.05	23.2	122.38
460/4h-600/30min	525	30.92	22.74	106.46

**Table S4.** The illuminance values of single-side embedded, double-side embedded, quad-side embedded, and straight-down blue light guide panels tested by the nine-point measuring method.

Irradiation intensity (W/m <sup>2</sup> )			
single-side LGP	double-side LGP	quad-side LGP	straight-down LGP
69.73	132.40	242.80	14.42
71.28	133.70	247.20	14.68
72.10	138.70	251.70	15.29
73.97	143.10	253.60	16.03
73.99	144.30	254.40	16.13
76.38	146.10	257.90	16.25
78.35	146.50	260.10	21.51
82.52	149.60	262.80	22.36
87.26	150.10	263.70	24.52

**Table S5.** The minimum ( $E_{\min}$ ) and average ( $E_{\text{ave}}$ ) illuminance values of single-side embedded, double-side embedded, quad-side embedded, and straight-down blue light guide panels tested by the nine-point measuring method to calculate illumination uniformity of LGP ( $U_0$ ).

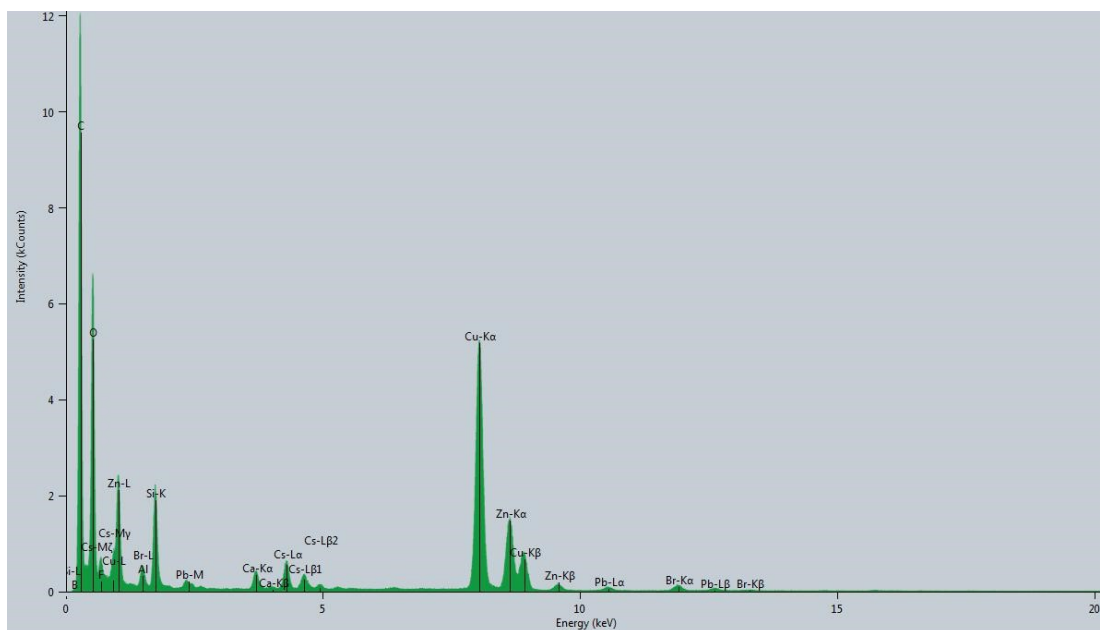
single-side LGP	double-side LGP	quad-side LGP	straight-down LGP
$E_{\min}=69.73$	$E_{\min}=132.40$	$E_{\min}=242.80$	$E_{\min}=14.42$
$E_{\text{ave}}=76.18$	$E_{\text{ave}}=142.72$	$E_{\text{ave}}=254.91$	$E_{\text{ave}}=17.91$
$U_0=91.5$	$U_0=92.8\%$	$U_0=95.2\%$	$U_0=80.5\%$

**Table S6.** CIE color coordinates for NTSC 1953 standard, Rec.2020 standard, commercial backlit display, and the CsPbBr<sub>3</sub>@glass@PDMS (sample A, narrow FWHM) based backlit displays with/without color filters.

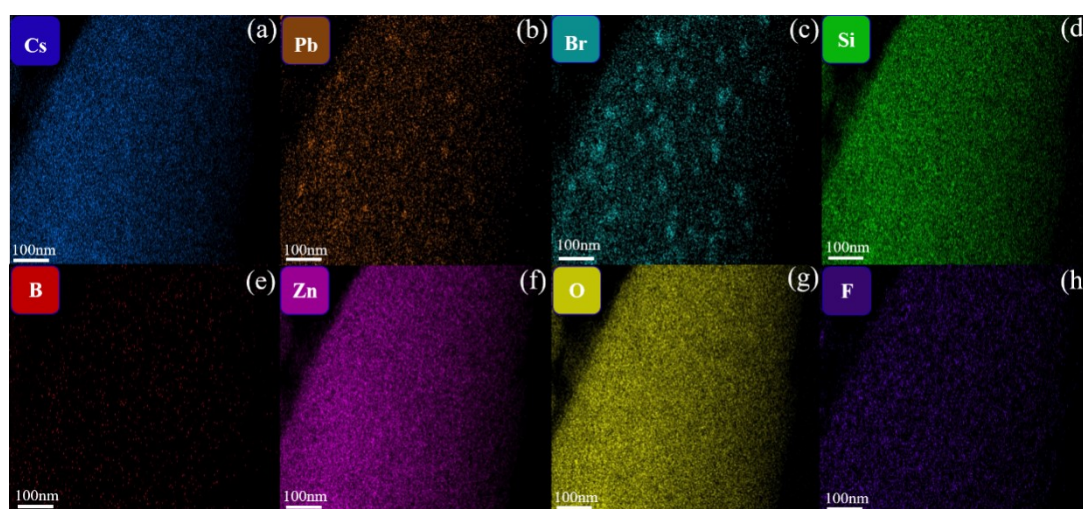
	NTSC	Rec.2020	Commercial backlit display	With color filter	Without color filter
Red	(0.67, 0.33)	(0.7079, 0.2920)	(0.6227, 0.3396)	(0.6873,0.3028)	(0.691,0.3088)
Green	(0.21, 0.71)	(0.1702, 0.7965)	(0.3142, 0.6007)	(0.1699,0.7202)	(0.1511,0.7794)
Blue	(0.14, 0.08)	(0.1314, 0.0459)	(0.1495, 0.0423)	(0.1447,0.0782)	(0.1463,0.0321)
Area	0.1582 (100%)	0.2116 (133.8%)	0.1076 (68%)	0.1713 (108.3%)	0.2029 (128.2%)

**Table S7.** CIE color coordinates for NTSC 1953 standard, Rec.2020 standard, commercial backlit display, and the CsPbBr<sub>3</sub>@glass@PDMS (sample B, wide FWHM) based backlit displays with/without color filters.

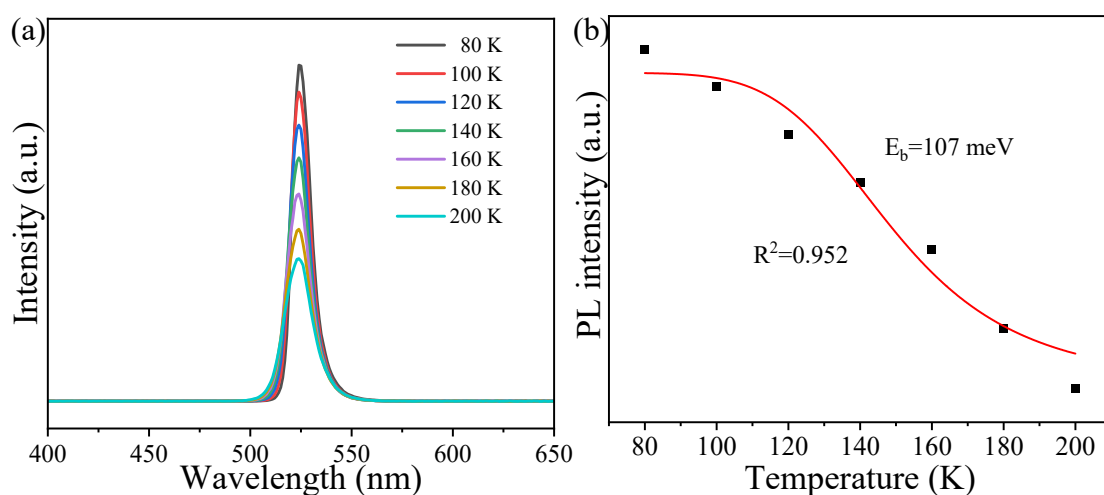
	NTSC	Rec.2020	Commercial backlit display	With color filter	Without color filter
Red	(0.67, 0.33)	(0.7079, 0.2920)	(0.6227, 0.3396)	(0.6859, 0.3019)	(0.689,0.3108)
Green	(0.21, 0.71)	(0.1702, 0.7965)	(0.3142, 0.6007)	(0.1443, 0.694)	(0.1174,0.7605)
Blue	(0.14, 0.08)	(0.1314, 0.0459)	(0.1495, 0.0423)	(0.1417,0.805)	(0.1467,0.0311)
Area	0.1582 (100%)	0.2116 (133.8%)	0.1076 (68%)	0.1666 (105.3%)	0.2019 (127.6%)



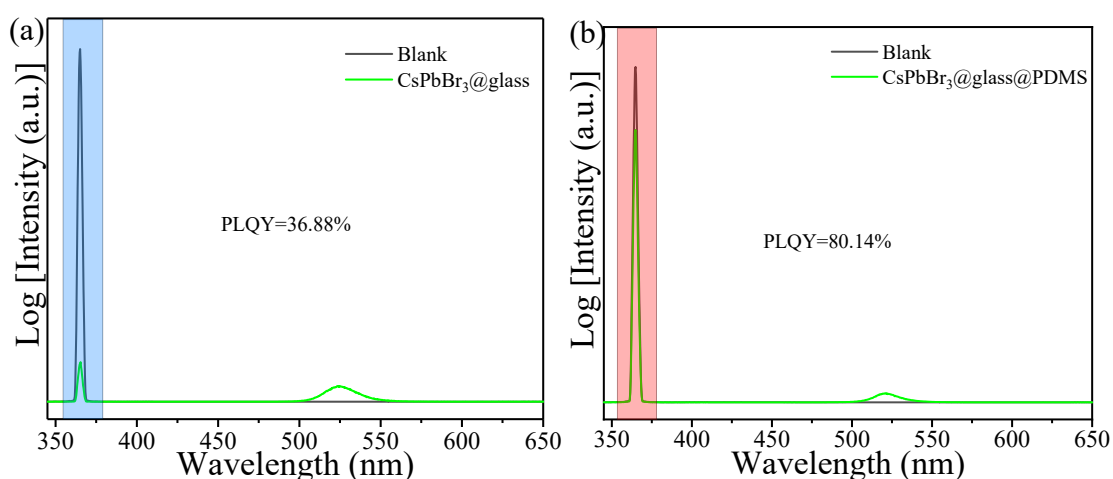
**Figure S1.** EDX spectrum of the as-prepared glass, showing the presence of Si, B, Zn, O, Ca, F, Cs, Pb and Br elemental signals.



**Figure S2.** Elemental mapping images for the CsPbBr<sub>3</sub> PQDs embedded glass.



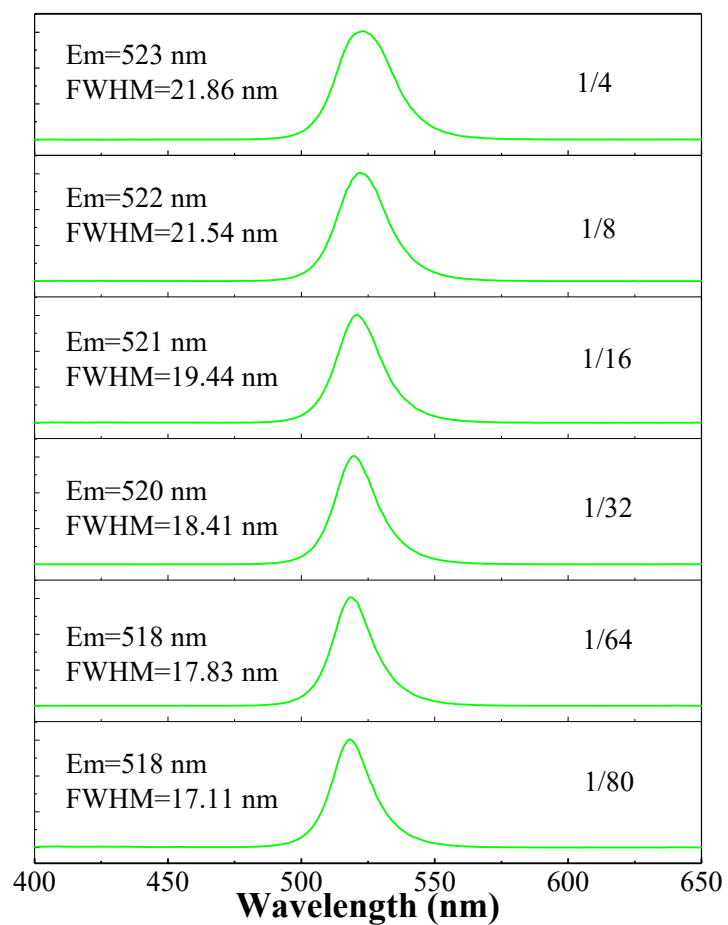
**Figure S3.** (a) Temperature dependence of PL spectra of CsPbBr<sub>3</sub>@glass sample. (b) The integrated emission intensity as a function of temperature from 80 K to 200 K and the fitted curve to evaluate exciton binding energy of 107 meV.



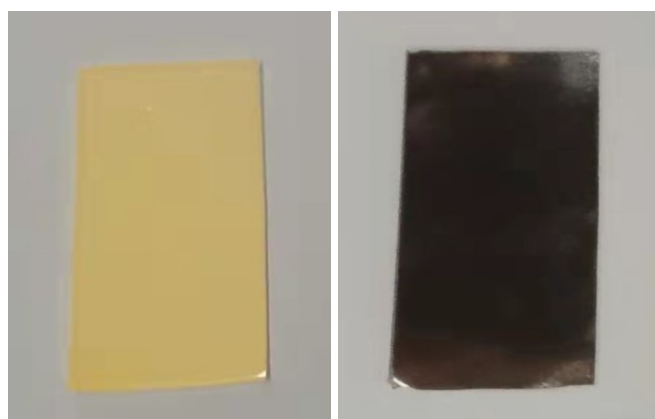
**Figure S4.** Quantitative PL spectra of (a) CsPbBr<sub>3</sub>@glass sample and (b) CsPbBr<sub>3</sub>@glass@PDMS mixture for the determination of absolute PLQYs.

Notably, the PLQY for the sample by single-step treatment can reach as high as ~100% by diluting the sample in PDMS. Unfortunately, their FWHMs are 26-28 nm and the peak emission wavelengths are 514-521 nm, which are not suitable for achieving a wide color gamut backlight display, especially after passing the color filters.

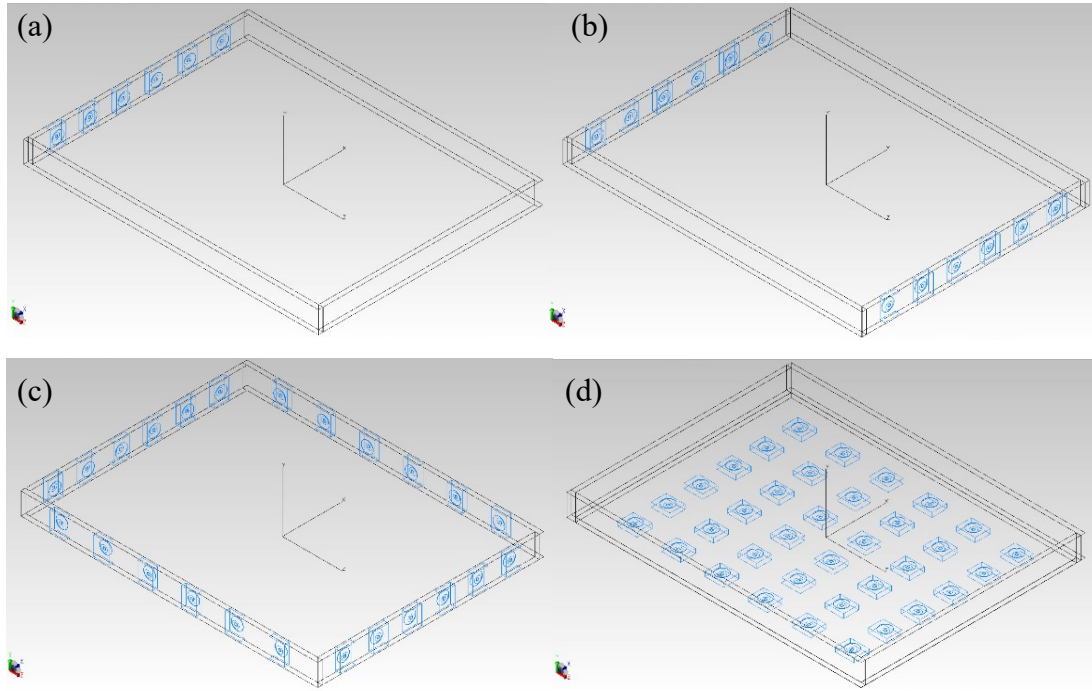




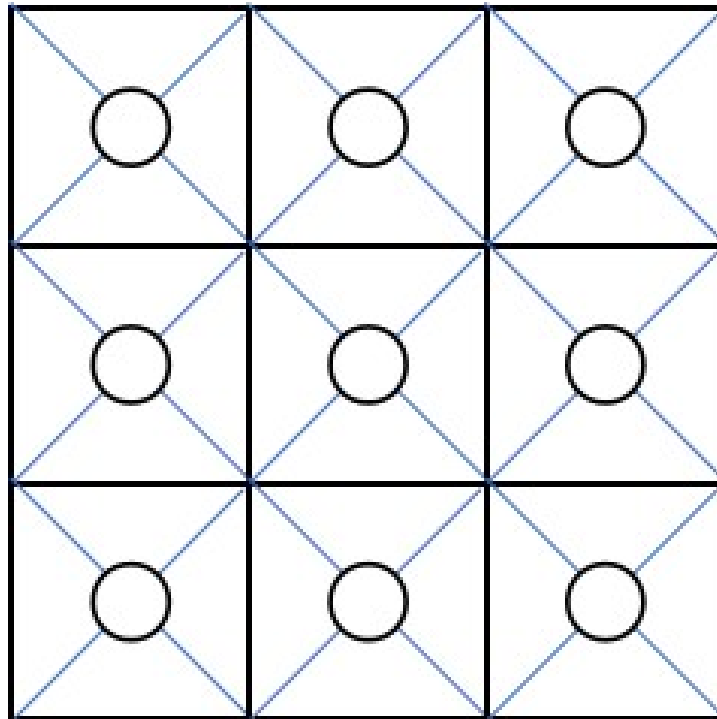
**Figure S5.** The dependence of PL spectrum for the (CsPbBr<sub>3</sub>@glass@PDMS) green film on the [CsPbBr<sub>3</sub>@glass]/PDMS weight ratio.



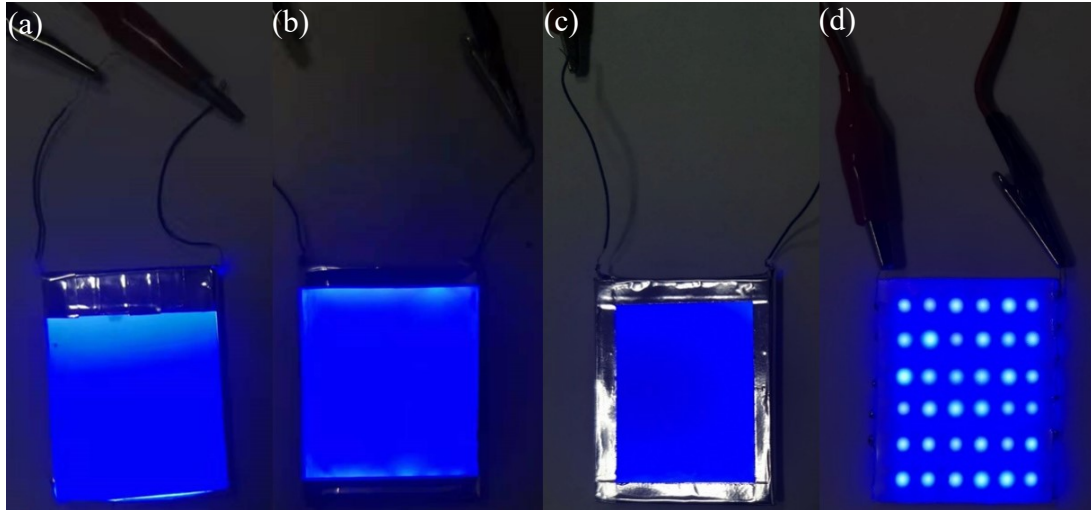
**Figure S6.** Photographs of the composite film containing CsPbBr<sub>3</sub>@glass and Mn: KSF powders without boiling (left) and after boiling at 85°C for 36 h (right).



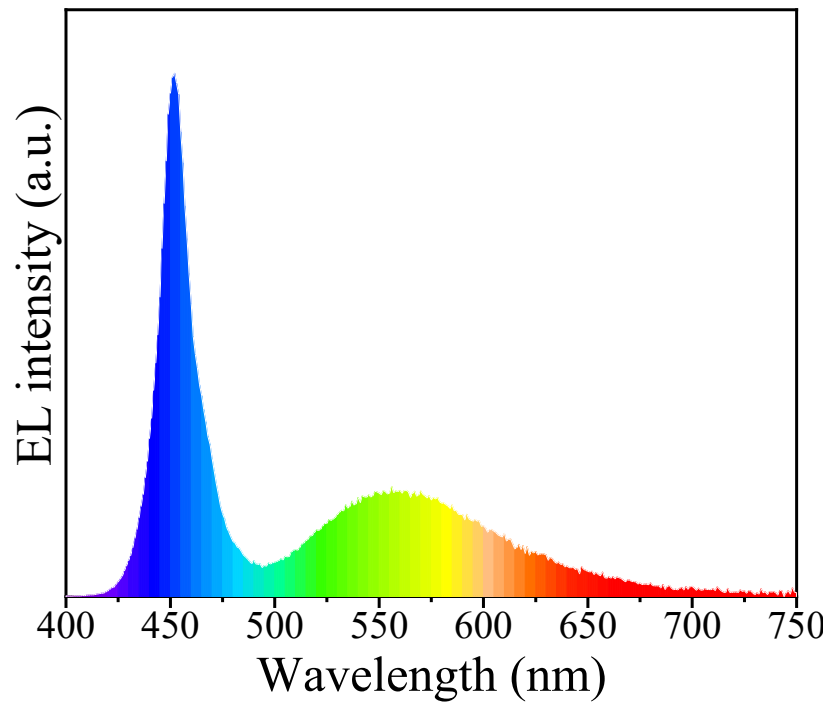
**Figure S7.** Schematic illustration of (a) single-side embedded, (b) double-side embedded, (c) quad-side embedded, and (d) straight-down blue light guide panels.



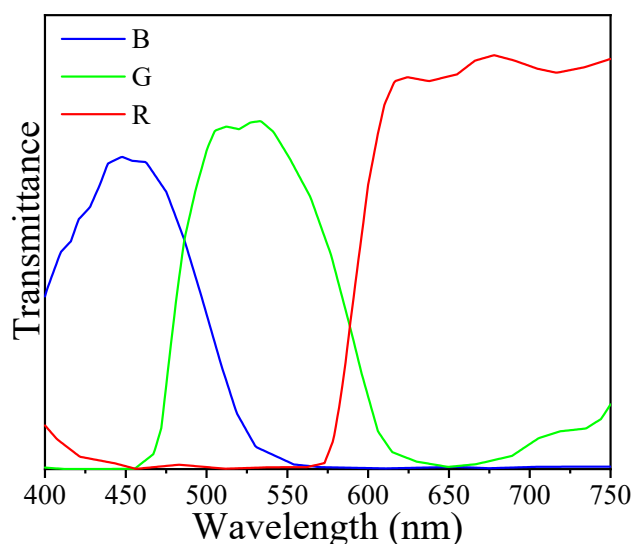
**Figure S8.** The schematic diagram of the nine-point measuring method to determine illumination uniformity of LGP.



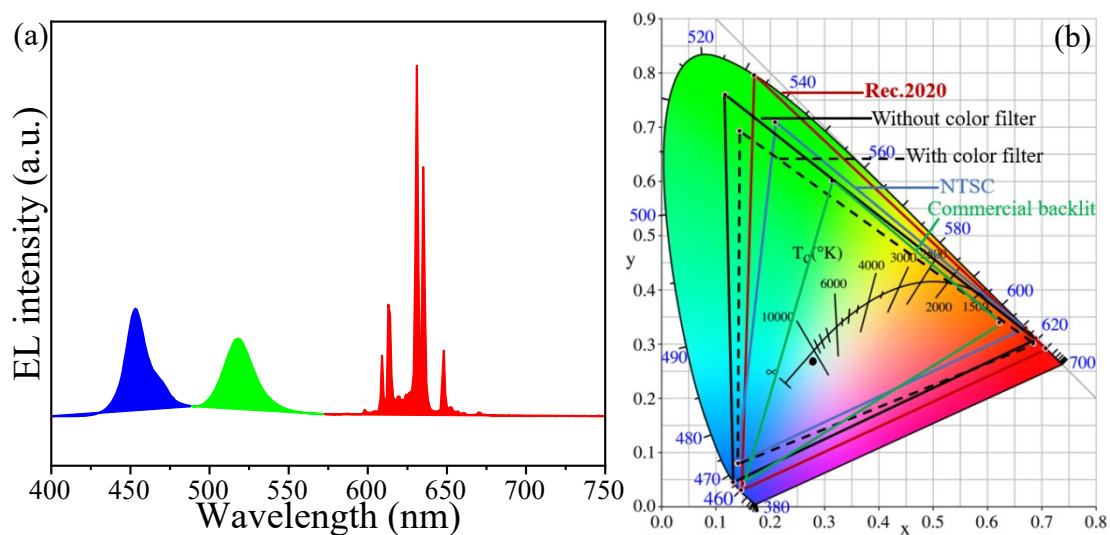
**Figure S9.** The physical pictures of the designed single-side embedded (a), double-side embedded (b), quad-side embedded (c), and straight-down (d) blue light guide panels under 3.3V applied voltage.



**Figure S10.** EL spectrum of a white backlight unit using a blue LED chip combined with commercial Ce: YAG yellow phosphors.



**Figure S11.** Transmittance spectra of commercial red, green, and blue (R, G, and B) color filters used in the backlit LCD.



**Figure S12.** (a) EL spectra of blue LGP combined with CsPbBr<sub>3</sub>@glass@PDMS (sample B, wide FWHM) green film and Mn: KSF red film white light backlight unit. (b) Color gamut of the commercial screen (green line), the CsPbBr<sub>3</sub>@glass@PDMS film screen with and without color filters (dash line and black line), NSTC 1953 standard (blue line) and Rec. 2020 standard (red line) in the CIE diagram.