Supporting Information

Efficient violet-light-excitable blue-cyan phosphor for full-spectrum lighting

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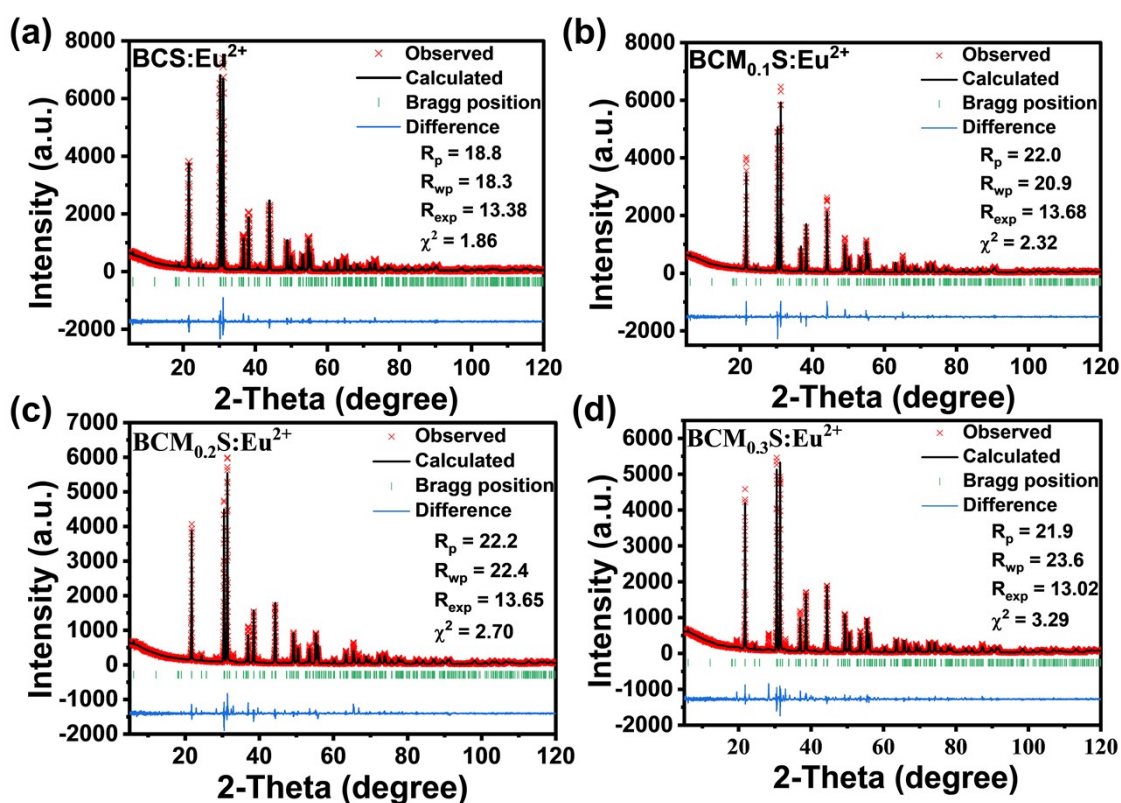
Figure S1. The Rietveld refinement of $BCM_xS:Eu^{2+}$ (x = 0, 0.1, 0.2 and 0.3) samples.
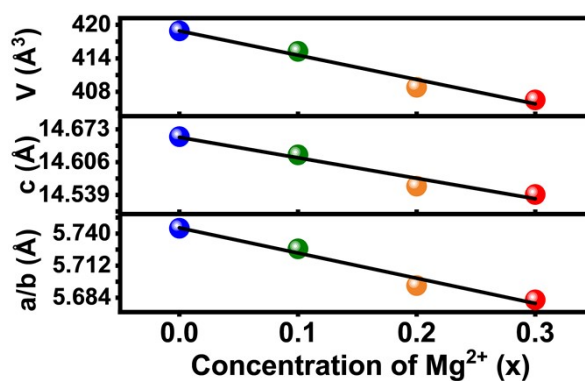

Figure S2. Dependence of cell paraments (a/b and c) and unit cell volume (V) on the concentration of Mg^{2+}.

Table S1. The refined atomic coordinates and chemistry occupancies of BCS sample[*]

Atoms	Wyckoff position	x	y	z	Occ
Ba1	6i	0.6597(7)	0.6597(7)	0.1590(1)	0.2217(0)
Ca1	6i	0.6597(7)	0.6597(7)	0.1590(1)	0.1116(3)
Ba2	6g	0.0894(4)	0.00000	0.00000	0.1433(6)
Ca2	6g	0.0894(4)	0.00000	0.00000	0.0233(1)
Ba3	2d	0.33330	0.66670	0.3429(5)	0.9918(0)
Ca3	2d	0.33330	0.66670	0.3429(5)	0.0082(0)
Ba4	2c	0.0000	0.00000	0.2387(4)	0.0368(9)
Ca4	2c	0.0000	0.00000	0.2387(4)	0.9631(1)
Ba5	1b	0.00000	0.00000	0.50000	1
Si1	2d	0.33330	0.66670	0.1175(3)	1
Si2	2d	0.33330	0.66670	0.6096(8)	1
O1	12j	0.1450(0)	0.3600(0)	0.1595(0)	0.5
O2	6i	0.7150(0)	0.7150(0)	0.4960(0)	0.3333(3)
O3	6i	0.8120(0)	0.8120(0)	0.3360(0)	0.5
O4	6i	0.8280(0)	0.8280(0)	0.3700(0)	0.5
O5	2d	0.33330	0.66670	0.0060(0)	1

[*]In the split-atom-site model of T-phase, the atom occupancies of M1, M2, O1, O2, O3 and O4 are 1/3, 1/6, 1/2, 1/3, 1/2 and 1/2, respectively.

Table S2. The refined atomic coordinates and chemistry occupancies of $BCM_{0.3}S$ sample[*]

Atoms	Wyckoff position	x	y	z	Occ
Ba1	6i	0.6645(5)	0.6645(5)	0.1619(6)	0.2361(3)
Ca1	6i	0.6645(5)	0.6645(5)	0.1619(6)	0.0972(0)
Ba2	6g	0.0759(6)	0.00000	0.00000	0.1432(5)
Ca2	6g	0.0759(6)	0.00000	0.00000	0.0234(2)
Ba3	2d	0.33330	0.66670	0.3409(0)	0.9917(2)
Ca3	2d	0.33330	0.66670	0.3409(0)	0.0082(8)
Ba4	2c	0.00000	0.00000	0.2472(1)	0.0234(5)
Ca4	2c	0.00000	0.00000	0.2472(1)	0.0415(6)
Mg1	2c	0.00000	0.00000	0.2472(1)	0.9349(9)
Ba5	1b	0.00000	0.00000	0.50000	1
Si1	2d	0.33330	0.66670	0.1152(8)	1
Si2	2d	0.33330	0.66670	0.6125(2)	1
O1	12j	0.1516(4)	0.3553(7)	0.1573(0)	0.5
O2	6i	0.7183(7)	0.7183(7)	0.4980(1)	0.3333(3)
O3	6i	0.7965(0)	0.7965(0)	0.3305(9)	0.5
O4	6i	0.8149(3)	0.8149(3)	0.3778(1)	0.5
O5	2d	0.33330	0.66670	0.0001(2)	1

[*]In the split-atom-site model of T-phase, the atom occupancies of M1, M2, O1, O2, O3 and O4 are 1/3, 1/6, 1/2, 1/3, 1/2 and 1/2, respectively.
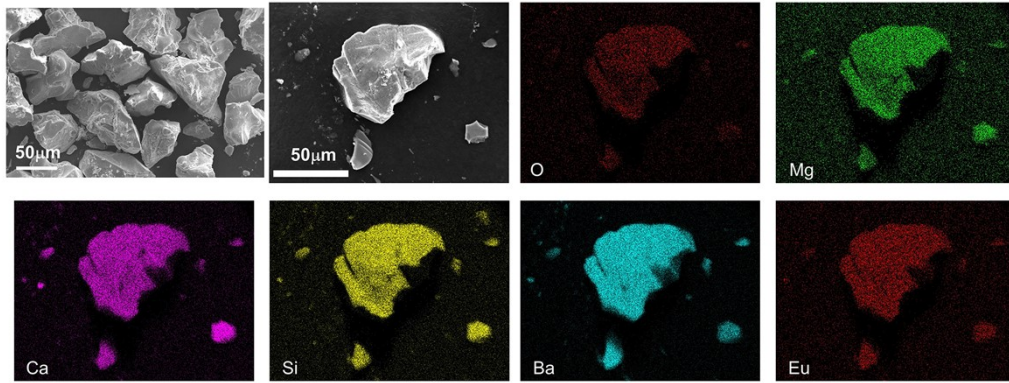
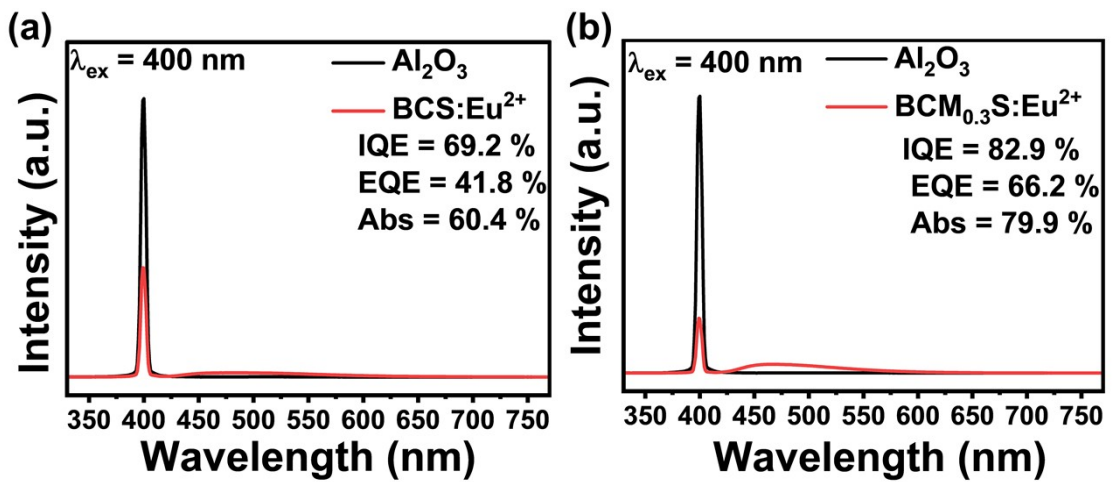**Figure S3.** The SEM image and elemental mapping images of $BCM_{0.3}S:Eu^{2+}$

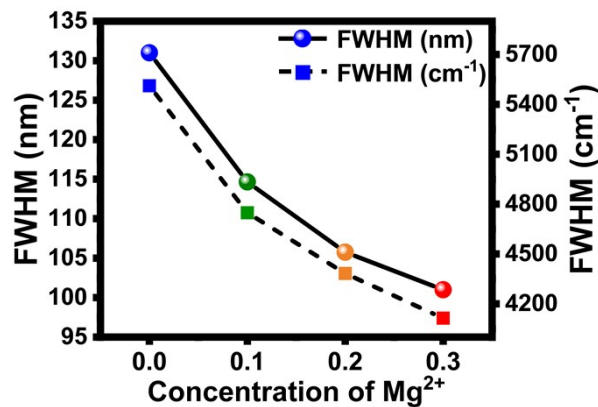**Figure S4.** Spectra to determine the quantum efficiency of (a) $BCS:Eu^{2+}$ and (b) $BCM_{0.3}S:Eu^{2+}$.

Figure S5. Dependence of FWHM on the concentration of Mg^{2+} in $BCM_xS:Eu^{2+}$ (x = 0, 0.1, 0.2 and 0.3) samples.
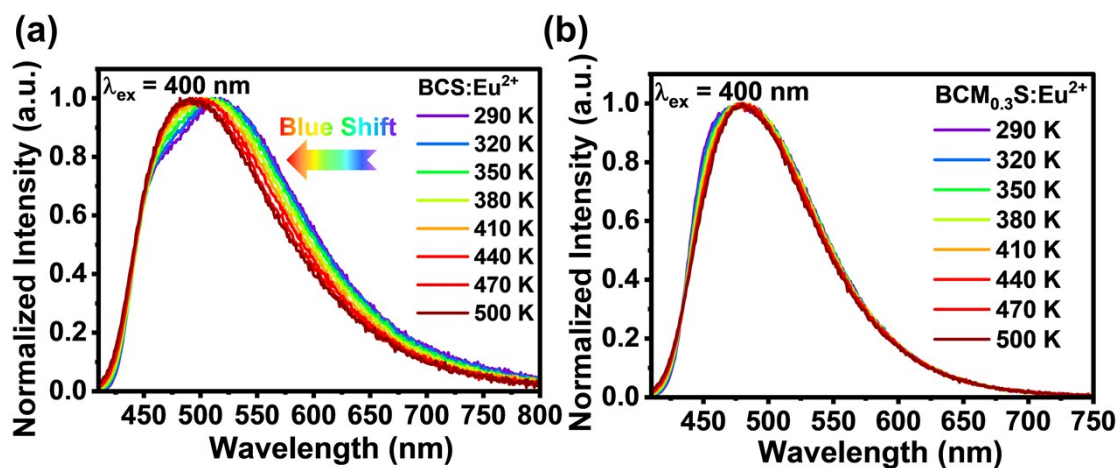
Figure S6. Normalized temperature-dependent PL spectra from 290-500 K for (a) BCS:Eu^{2+} and (b) BCM$_{0.3}$S:Eu^{2+}.