A Novel Extra-Broadband Visible Emitting Garnet Phosphor toward Efficient Single Component Pc-WLED

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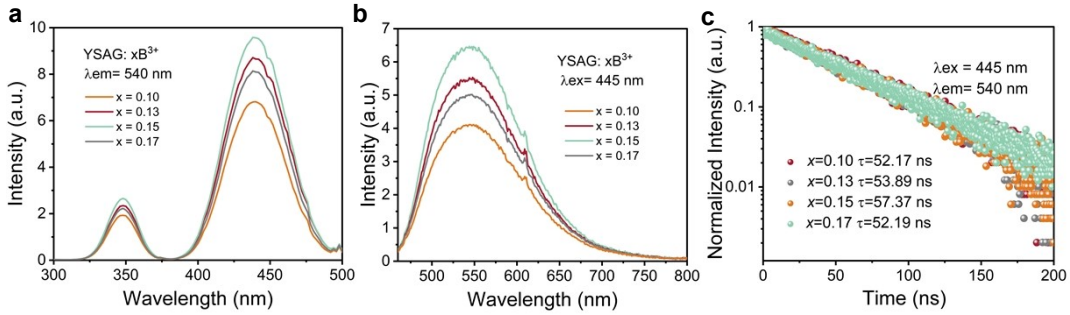

Figure S1. **B^{3+}-concentration dependent luminous properties of YSAG: xB^{3+} (x = 0.10- 0.17) samples. a** PLE and **b** PL spectra. **c** The decay curves at RT of YSAG: xB^{3+} (x=0.10 to 0.17) under 445 nm excitation monitored.

The lifetime was calculated by using Equation (1), as follows[1]:

$$I(t) = I_o + A_1\exp(-t/\tau_1) + A_2\exp(-t/\tau_2) \quad (1)$$

The average life value can be subsequently found as follows:

$$\tau^* = \frac{A_1\tau_1^2 + A_2\tau_2^2}{A_1\tau_1 + A_2\tau_2} \quad (2)$$

where $I(t)$ refer to the time-dependent intensity, τ represents the lifetime values of different decay components and A_1 and A_2 are fitting constants.

Table S1. XRF results of YSAG: $0.15B^{3+}$.

Analyte	Calibration	Compound formula	Concentration
Al	Calibrated	Al_2O_3	24.280%
Y	Calibrated	Y_2O_3	52.730%
Sc	Calibrated	Sc_2O_3	21.984%
Si	Calibrated	SiO_2	0.177%
S	Calibrated	SO_3	0.028%
Ca	Calibrated	CaO	0.036%
Fe	Calibrated	Fe_2O_3	0.031%
Ni	Calibrated	NiO	0.317%
Ge	Calibrated	GeO_2	0.372%
Sm	Calibrated	Sm_2O_3	0.040%
W	Calibrated	WO_3	0.125%

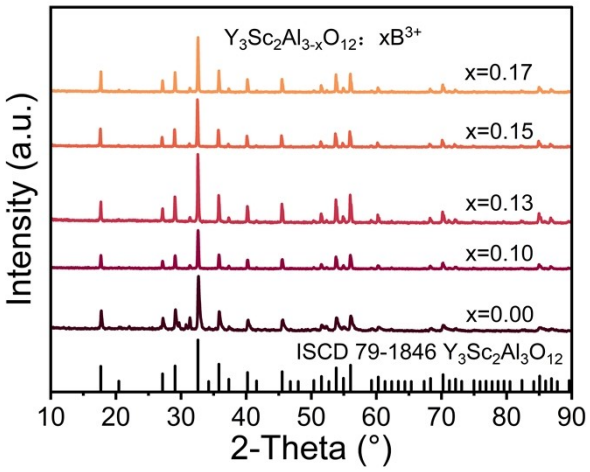

Figure S2. Phase confirmation of YSAG: xB^{3+} (x = 0.00-0.17) samples at room temperature. The X-ray diffraction peaks could be well indexed with the standard card of $Y_3Sc_2Al_3O_{12}$ (PDF No. 79-1846), thereby indicating the formation of a targeted phase.

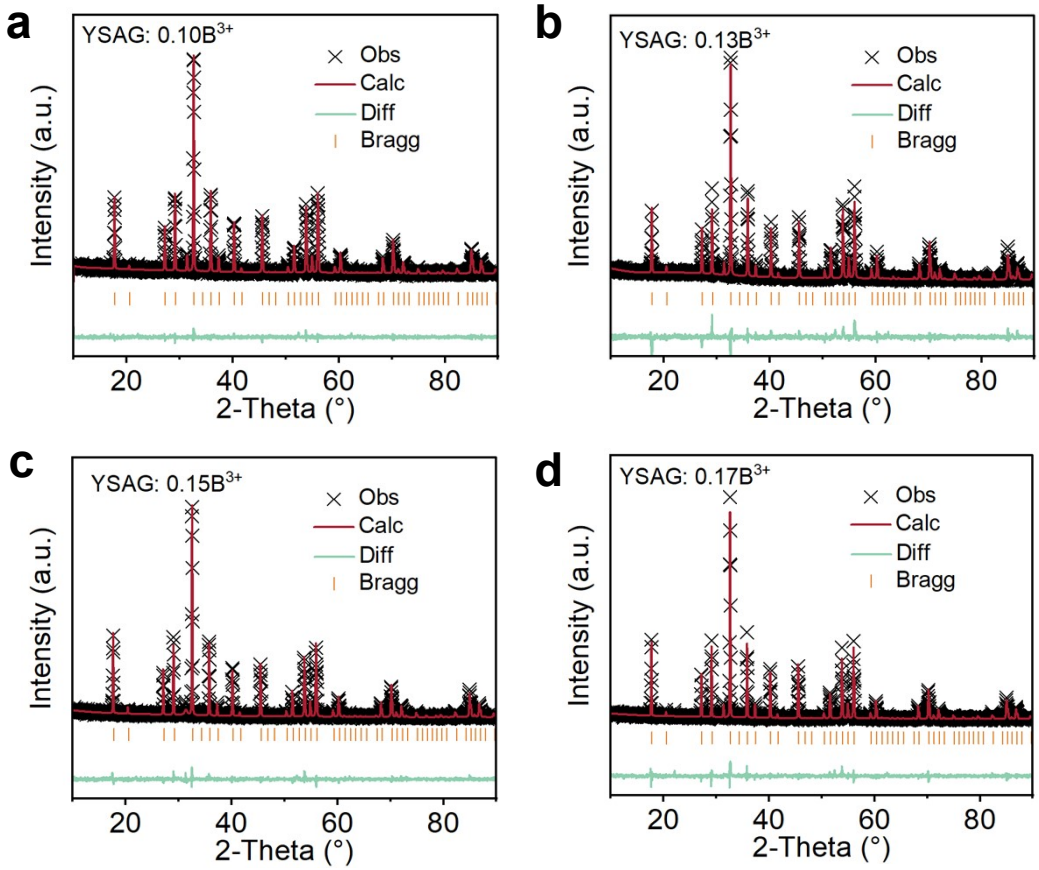

Figure S3. The Rietveld refinement XRD patterns of YSAG: xB^{3+} (x = 0.00, 0.10, 0.13 and 0.17) samples

Table S2 Crystallographic data of $Y_3Sc_2Al_{3-x}O$: xB^{3+} (x = 0.0, 0.10, 0.13, 0.15 and 0.17) samples based on Rietveld refinements.

Formula	**x=0.0**	**x=0.10**	**x=0.13**	**x=0.15**	**x=0.17**
Crystal system	Cubic	Cubic	Cubic	Cubic	Cubic
Space group	Ia3d	Ia3d	Ia3d	Ia3d	Ia3d
a=b=c (Å)	12.252	12.277	12.280	12.292	12.297
α=β=γ (°)	90	90	90	90	90
volume (Å^3)	1839.456	1850.666	1851.913	1857.189	1859.435
Z	16	16	16	16	16
R_{wp} (%)	14.202	11.251	9.196	10.979	11.710
GOF	2.40	1.27	1.34	1.27	1.36
χ^2	5.78	1.60	1.81	1.61	1.85

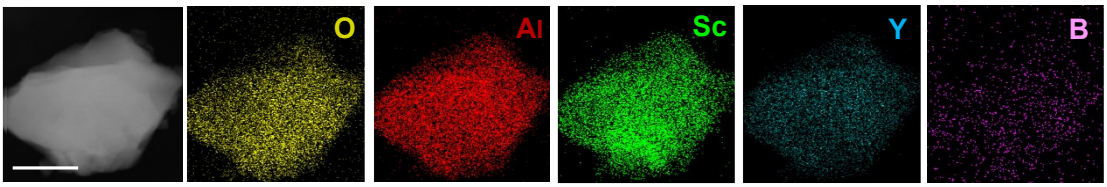

Figure S4. TEM image of the YSAG: $0.15B^{3+}$ single particle and its component elemental maps (scale bar: 100 nm).

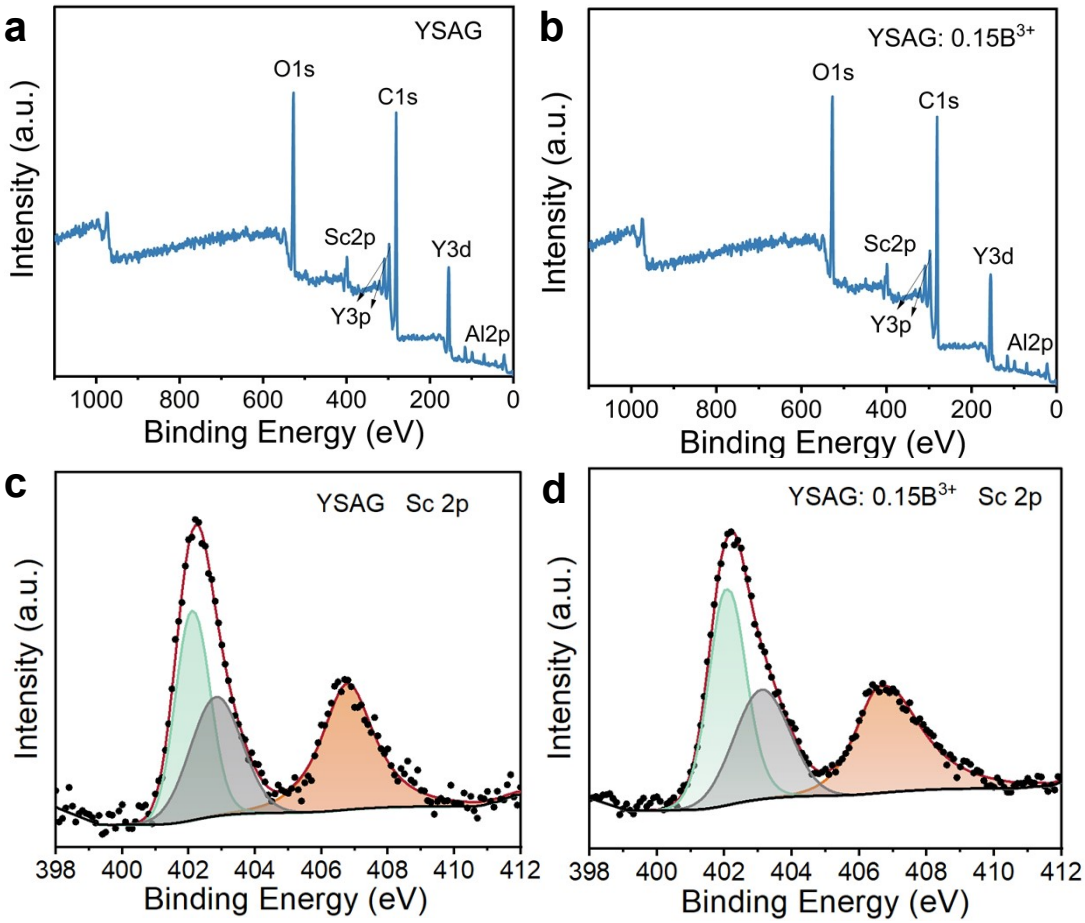

Figure S5. The XPS survey scan of YSAG and YSAG: 0.15B^{3+}. a-b full spectrum scanning. **c--d** XPS analysis of the Sc 2p orbital.

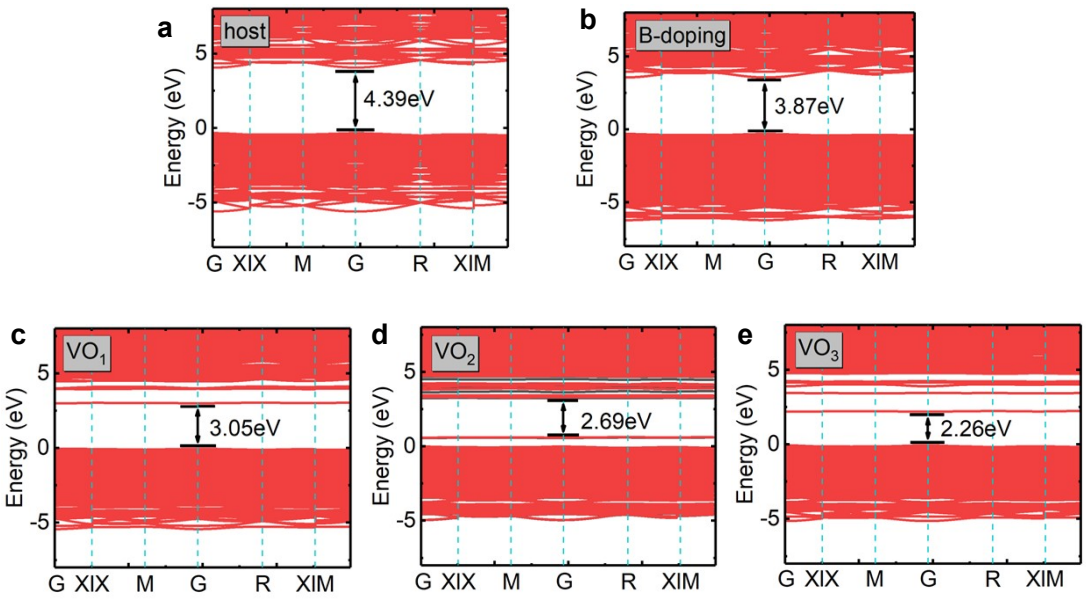

Figure S6. Band structure of **a** YSAG matrix and **b** YSAG: B^{3+} without oxygen vacancy. **c-e** Band structure of YSAG: B^{3+} with oxygen vacancies.

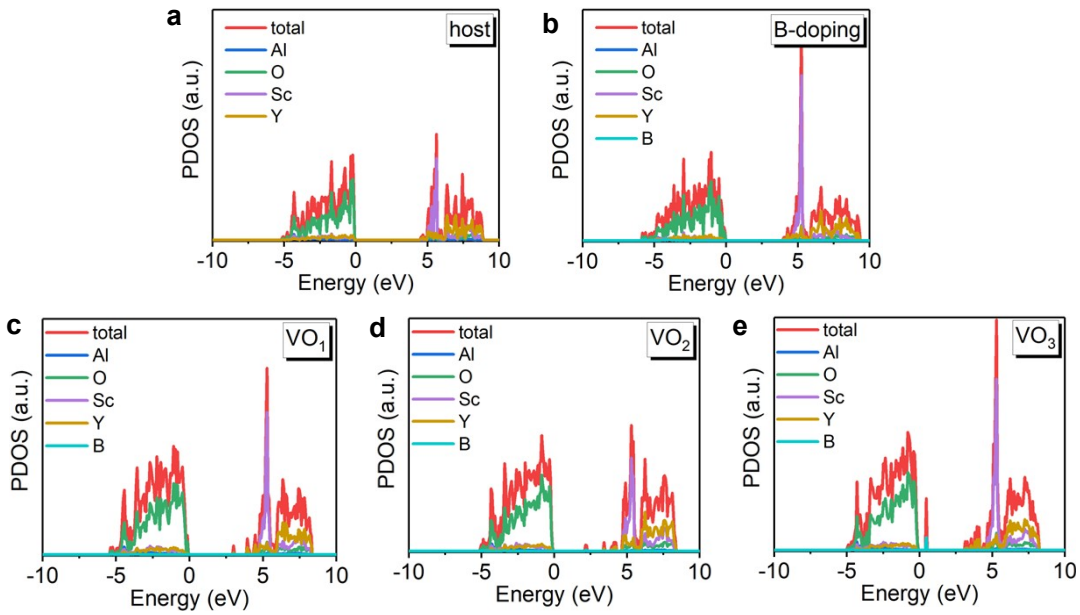

Figure S7. PDOS of YSAG matrix and YSAG: B^{3+} without and with oxygen vacancies.

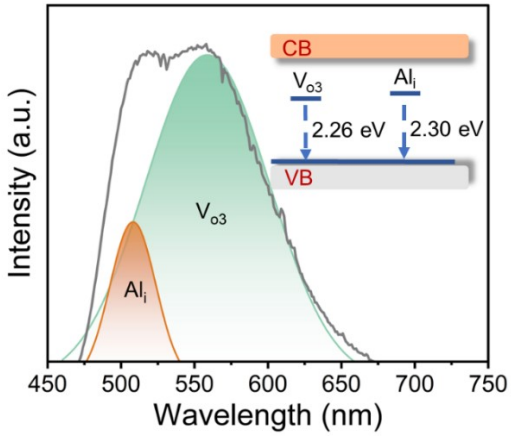

Figure S8. The Gaussian fitting peak of the representative YSAG: $0.15B^{3+}$ sample

Reference

1. Q. Chen, M. Wu, P. Xiong, Y. Zhao, S. Tian, Y. Xiao, Y. Sun, D. Chen, S. Xu and Z. Yang, Efficient and Broadband Emission in Dy^{3+}-Doped Glass-Ceramic Fibers for Tunable Yellow Fiber Laser, *Nanomaterials*, 2023, **13**.