Remarkable near-infrared emission enhancement of Cr^{3+}-activated $BaGe_4O_9$: The role of lithium ion

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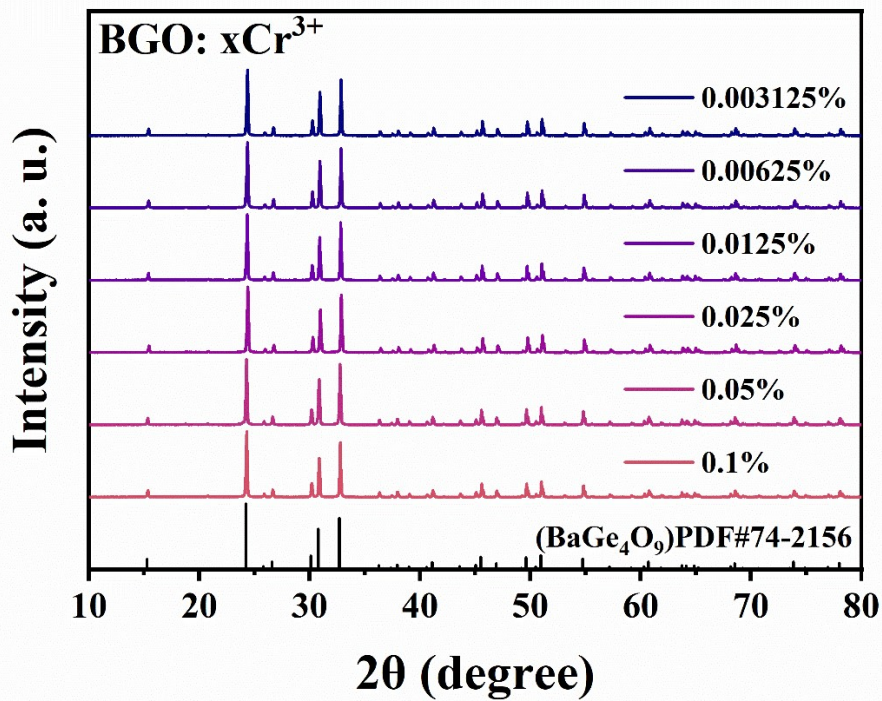
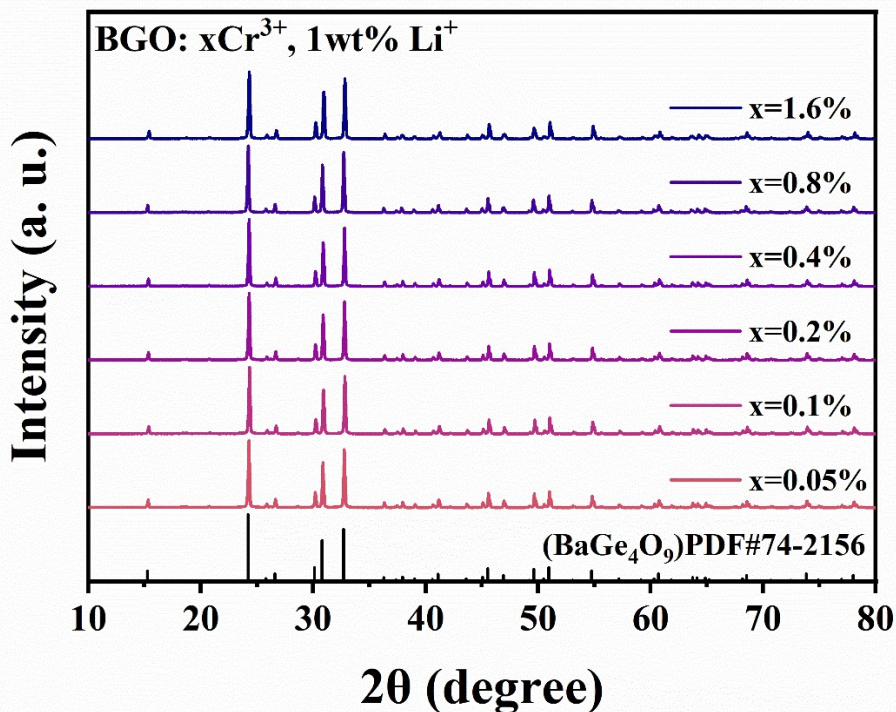**Fig. S1** XRD patterns of BGO:xCr^{3+} (x=0.003125%~0.1%) phosphors.

Fig. S2 XRD patterns of BGO:xCr^{3+},1wt%Li^+ (x=0.05%~1.6%) phosphors.
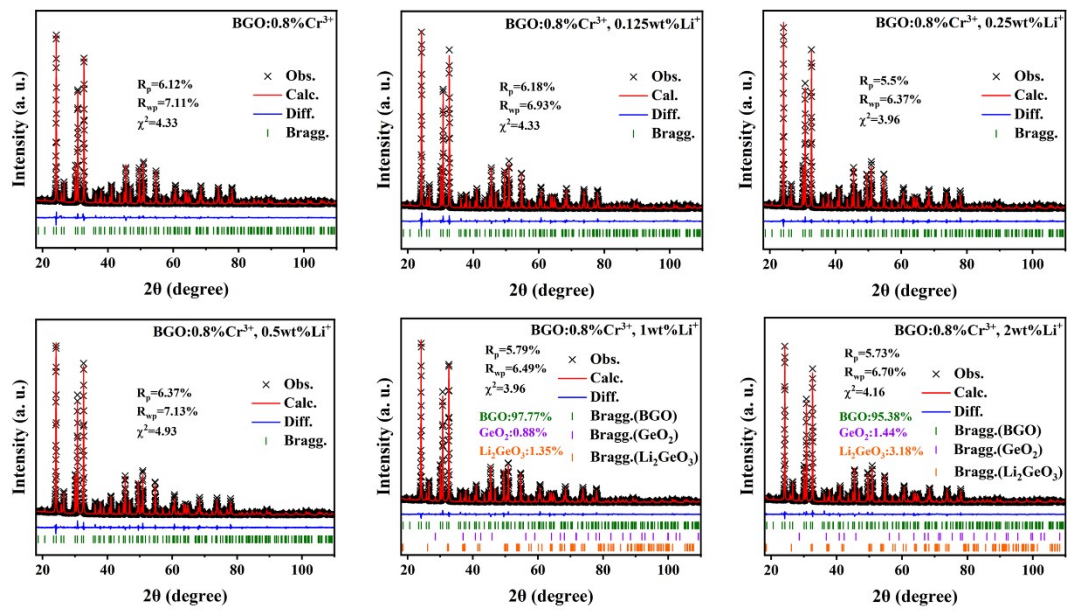
Fig. S3 XRD Rietveld refinements of BGO:0.8%Cr^{3+},yLi^+ (y=0-2wt%) phosphors.
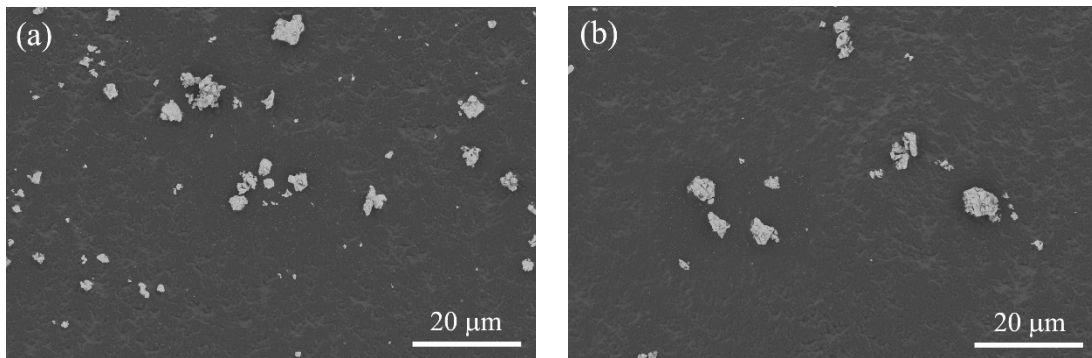
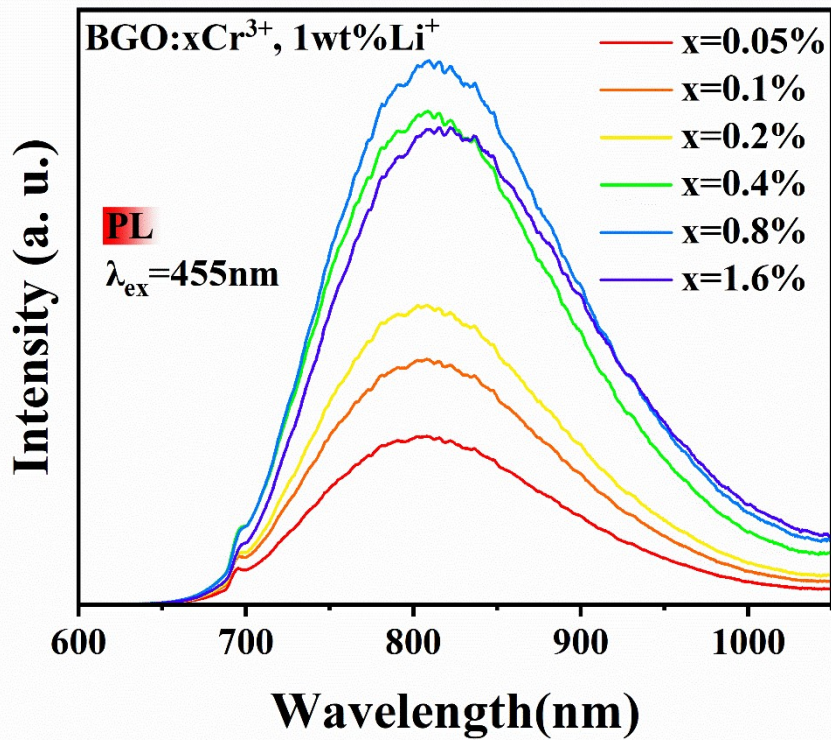**Fig. S4** SEM images of (a) BGO:Cr^{3+} and BGO:Cr^{3+},Li^+ phosphors

Fig. S5 PL spectra of BGO:xCr^{3+},1wt%Li^+ (x=0.05%-1.6%) phosphors.
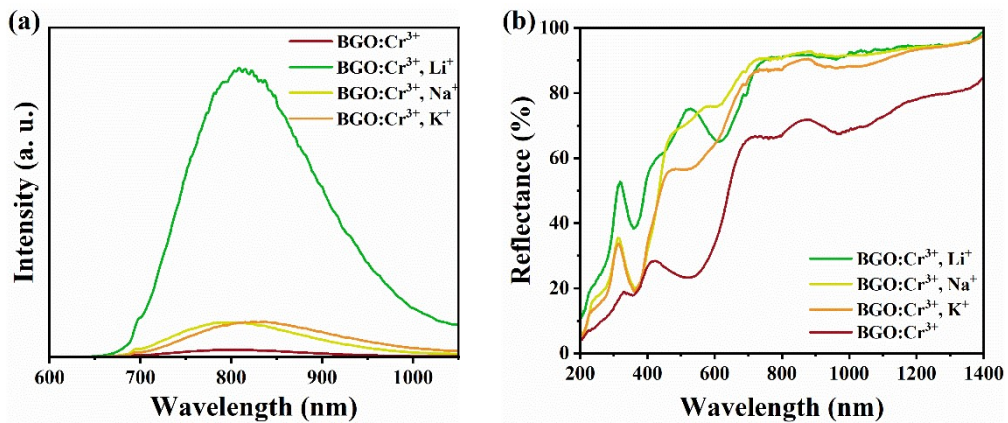

Fig. S6 (a) PL spectra and (b) diffuse reflectance spectra of BGO:Cr^{3+}, BGO:Cr^{3+},Li^+, BGO:Cr^{3+},Na^+ and BGO:Cr^{3+},K^+.

Table S1 Ionic radius differences between Li^+ and host cations

Ion	Li^+ (CN=8)	Ba^{2+} (CN=8)	Li^+ (CN=6)	Ge^{4+} (CN=6)	Li^+ (CN=4)	Ge^{4+} (CN=4)
Ionic radius (Å)	0.92	1.42	0.76	0.53	0.59	0.39
Ionic radius difference (%)	35%		43%		51%	

The ionic radius difference (D_r) is calculated by the following equation

$$D_r = \left| \frac{R_s(CN) - R_d(CN)}{R_s(CN)} \right| \times 100\%$$

where R_s is the ionic radius of the cations possibly substituted by Li^+, R_d is the ionic radius of Li^+ and CN represents coordination number.