

## Defect-Engineered $\text{Mn}^{2+}$ , $\text{Ga}^{3+}$ Co-Doped $\text{Li}_2\text{ZnGeO}_4$ Phosphors Exhibiting Long-Lasting Green Luminescence for Advanced Optoelectronic Applications

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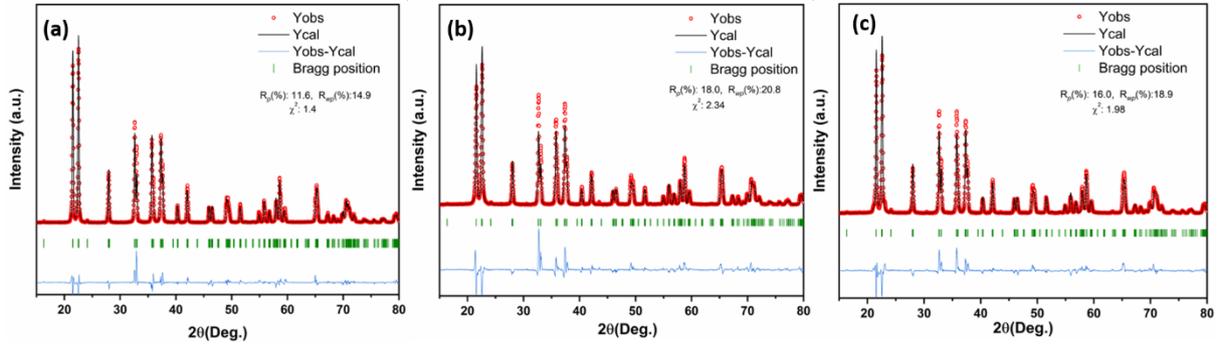
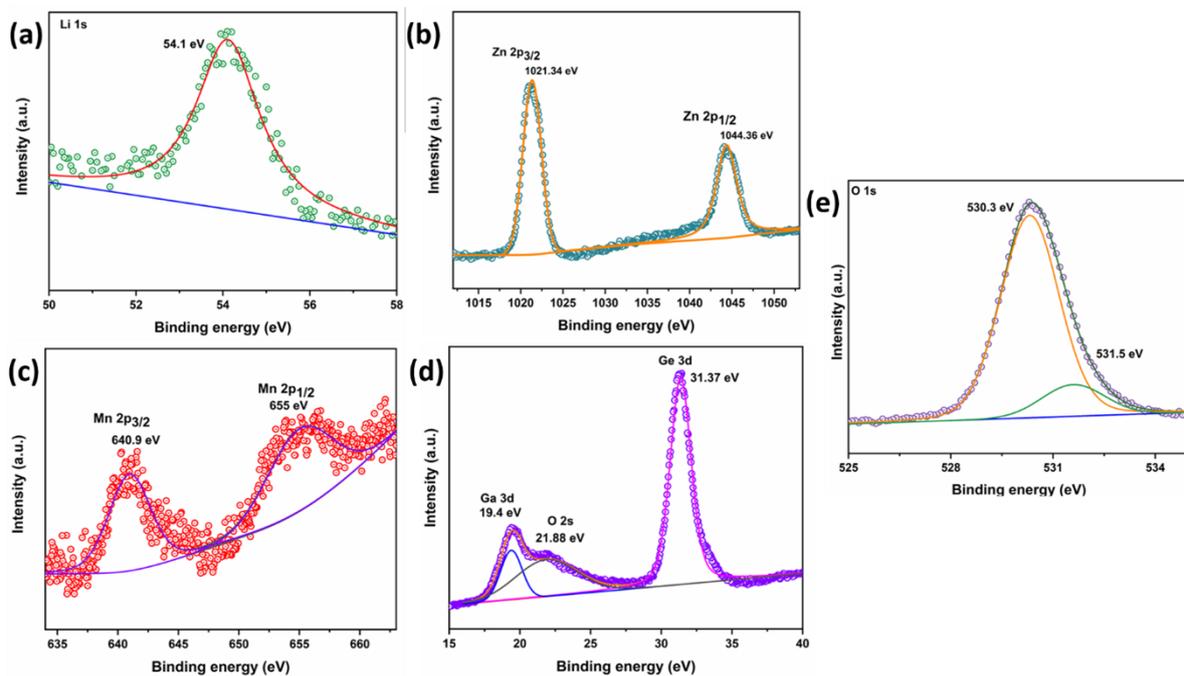


Figure S1: Rietveld refinement plot of (a) LZGO (b) LZGO-10Ga (c) LZGGO-0.5Mn

Table S1: Rietveld refinement lattice parameters of LZGO, LZGO-10Ga and LZGGO-0.5Mn

Samples	Unit cell parameters(Å)			Unit cell volume (Å <sup>3</sup> )
	a	b	c	
LZGO	6.361	5.434	5.031	173.96
LZGO-10Ga	6.361	5.422	5.022	173.25
LZGGO-0.5Mn	6.365	5.429	5.024	173.63



**Figure S2: High resolution spectra of (a) Li 1s (b) Zn 2p (c) Mn 2p (d) Ga 3d, Ge 3d (e) O 1s of LZGGO: 2% Mn<sup>2+</sup>**

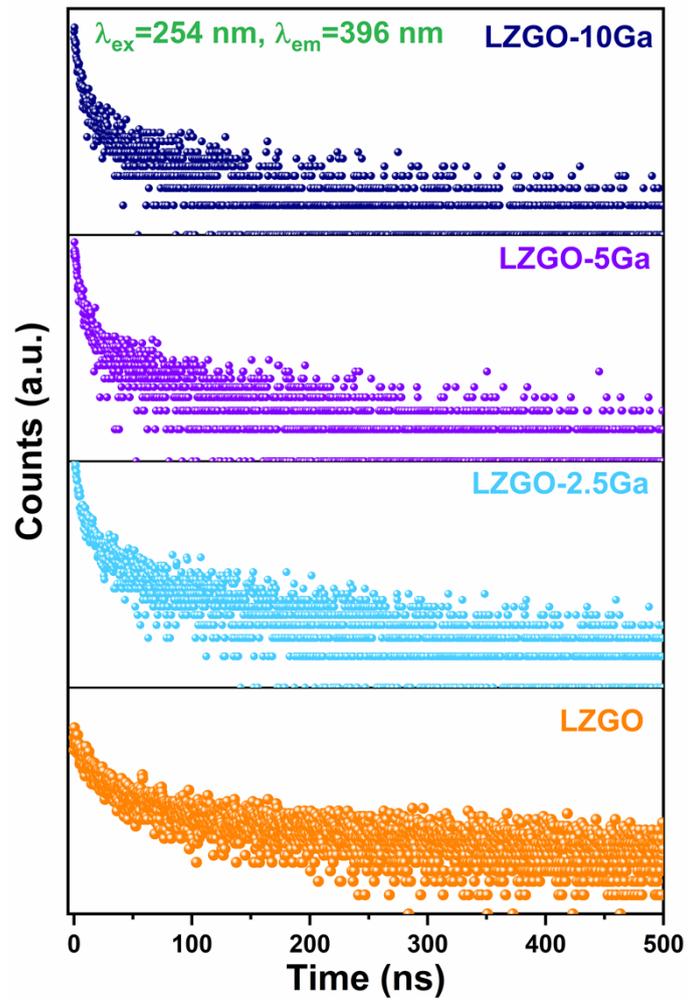
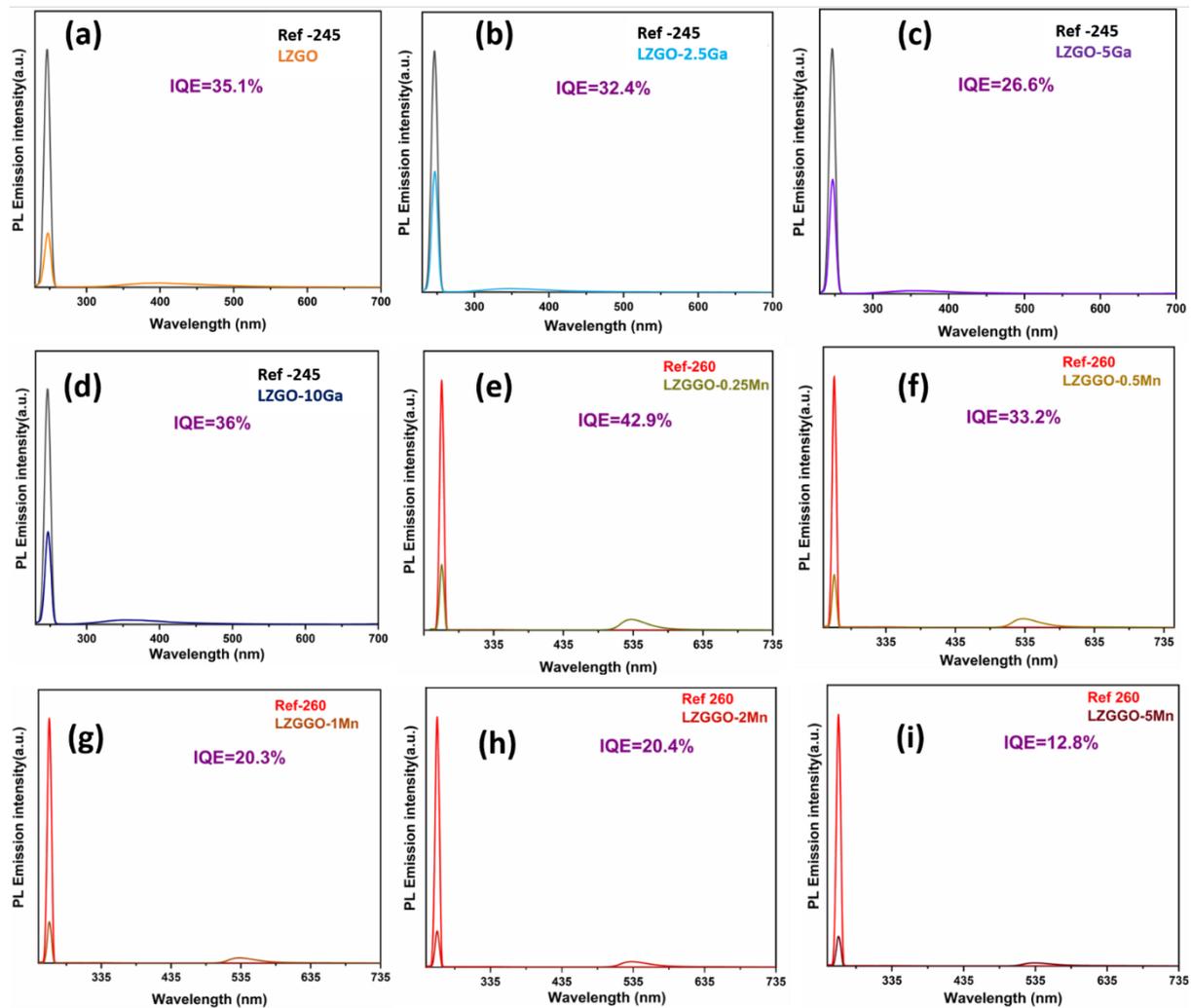


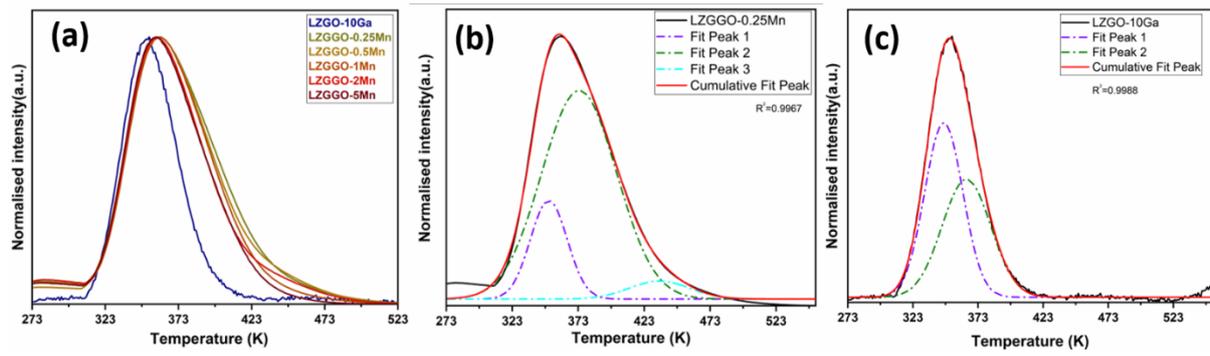
Figure S3: Decay plot of Ga doped LZGO (Ga (%)=0, 2.5, 5, 10)



**Figure S4: spectra for quantum yield of (a) LZGO, (b) LZGO-2.5Ga, (c) LZGO-5Ga, (d) LZGO-10Ga, (e) LZGGO-0.25Mn, (f) LZGGO-0.5Mn, (g) LZGGO-1Mn, (h) LZGGO-2Mn, (i) LZGGO-5Mn**

**Table S2: FWHM, IQE and EQE values of phosphors**

<b>Phosphor</b>	<b>FWHM</b>	<b>IQE (%)</b>	<b>EQE (%)</b>
LZGO	117	35.1	26.7
LZGO-2.5Ga	89.6	32.4	17
LZGO-5Ga	105	27	15.3
LZGO-10Ga	111.4	36	22.5
LZGGO-0.25Mn	43.4	43	31.4
LZGGO-0.5Mn	43.8	33.2	26.1
LZGGO-1Mn	45.4	20.3	16.8
LZGGO-2Mn	44.9	20.4	17.4
LZGGO-5Mn	47.5	12.8	11.2



**Figure S5: (a) Normalised thermoluminescence spectra of LZGO-10Ga, LZGGO:  $y\%$   $Mn^{2+}$ . Fitted TL spectra of (b) LZGGO-0.25Mn and (c) LZGO-10Ga.**