

Supporting Information

Broadband and High internal quantum efficiency near-infrared phosphors utilizing a chemical unit co-substitution strategy for plant lighting

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Determination of phytochrome

Fresh samples of 0.5 g of leaves were immersed in 50 ml centrifuge tubes containing 25 ml of equal volume of a mixture of acetone and anhydrous ethanol for a period of generally 24 h. Until the slices whitened, the supernatant was removed and used for the determination of the values of OD₆₄₅, OD₆₆₃, and OD₄₄₀ with the use of a blank solvent as a control by using an ultraviolet spectrophotometer. Calculate the pigment content:

Chlorophyll a concentration (mg/L) = $12.7 \times \text{OD}_{663} - 2.69 \times \text{OD}_{645}$

Chlorophyll b concentration (mg/L) = $22.9 \times \text{OD}_{645} - 4.86 \times \text{OD}_{663}$

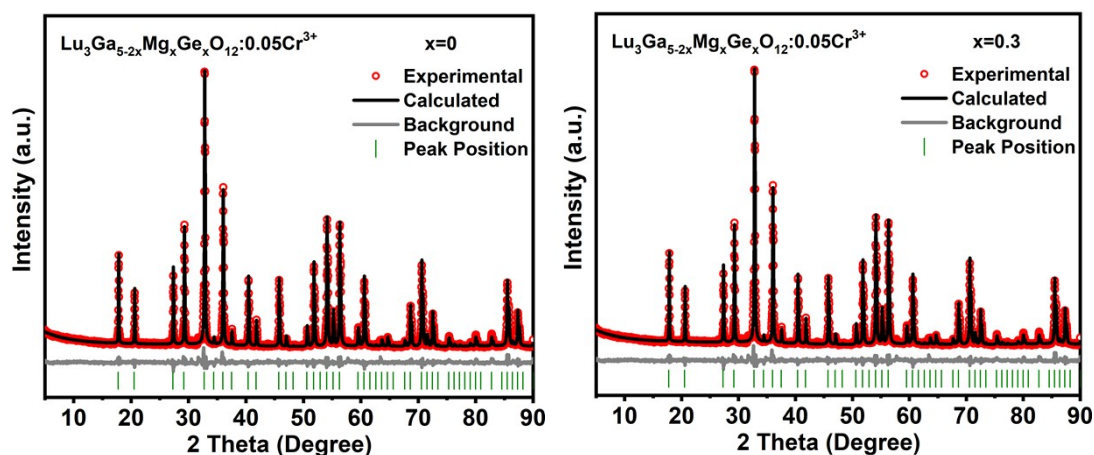


Fig. S1 The Rietveld refinement data LGMG:0.05Cr³⁺.

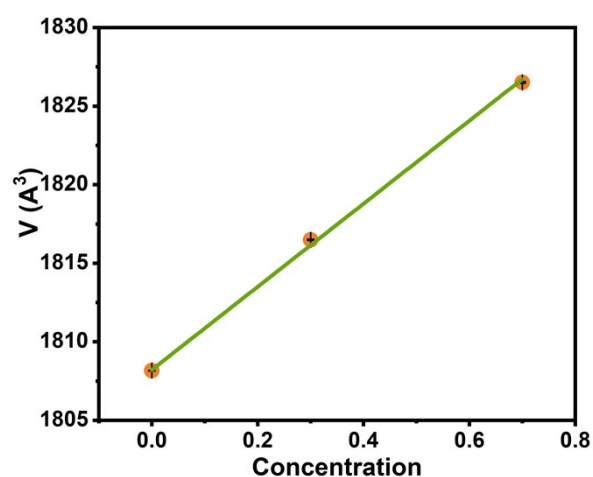


Fig. S2 The Rietveld refinement data LGMG:0.05Cr³⁺.

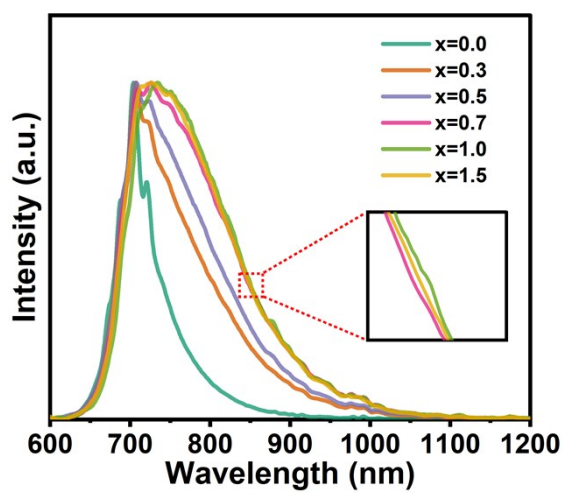


Fig. S3 PL spectrum of Lu₃Ga_{5-2x}Mg_xGe_xO₁₂:0.05Cr³⁺.

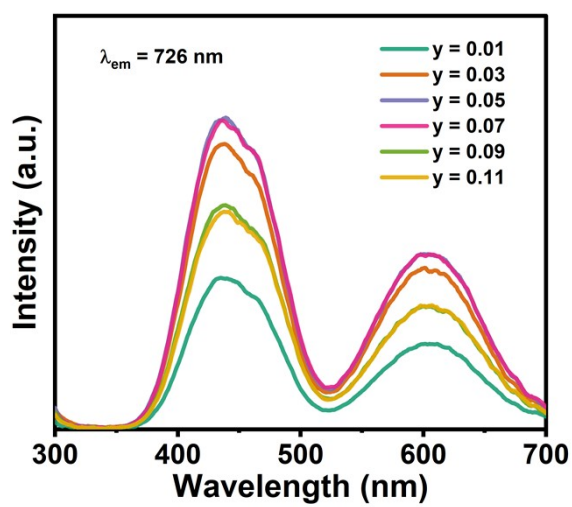


Fig. S4 PLE spectrum of $\text{Lu}_3\text{Ga}_{5-2x}\text{Mg}_x\text{Ge}_x\text{O}_{12}:0.05\text{Cr}^{3+}$.

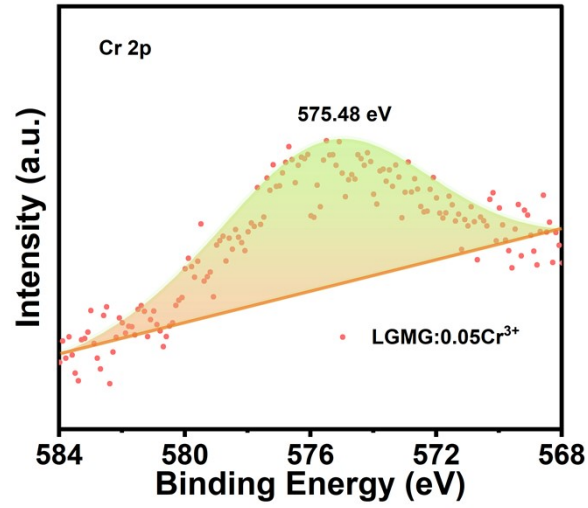


Fig. S5 XPS spectra of the Cr^{3+} 2p orbitals in LGMG:0.05Cr³⁺.

Table S1. Crystallographic data of LGMG with different x values.

x	Space Group	Cell parameters (Å),	Rwp, Rp, RB, χ^2
		Cell Volume (Å ³)	
0	<i>la-3d</i>	$a = 12.182307(48),$ $V = 1807.959(21)$	6.52, 4.6, 1.36, 4.28
0.3	<i>la-3d</i>	$a = 12.201372(96),$ $V = 1816.461(43)$	5.76, 3.99, 1.46, 3.87
0.7	<i>la-3d</i>	$a = 12.22358(12),$ $V = 1826.395(53)$	5.7, 3.99, 2.82, 3.62

Table S2. Crystal field strength data for different x values in Lu₃Ga₅₋_{2x}Mg_xGe_xO₁₂:0.05Cr³⁺ phosphors.

x	ΔS (cm ⁻¹)	Dq (cm ⁻¹)	$10Dq/B$ (cm ⁻¹)
X=0.0	2441.9	1544.6	24.2
X=0.3	2399.4	1538.4	24.0
X=0.5	2397.3	1530.3	23.9
X=0.7	2673.3	1511.1	23.5