

SUPPLEMENTARY INFORMATION

Augmenting Cyan Emission in Vanadate Garnet *via* Dy³⁺ Activation for Light Emitting Devices and Multi-Mode Optical Thermometry

Amrithakrishnan Bindhu^a, Jawahar I. Naseemabeevi^a, Subodh Ganesanpotti^a *

^aDepartment of Physics, University of Kerala, Kariavattom Campus, Thiruvananthapuram,
Kerala - 695 581, India

Email: gsubodh@gmail.com, gsubodh@keralauniversity.ac.in

Table S1. The percentage difference of Ionic radii (D_r) between host cations and Dy^{3+} .

Host cation (CN)	Doped ion (CN)	R_m (Å)	R_d (Å)	D_r (%)
Sr^{2+} (8)	Dy^{3+} (8)	1.26	1.027	18.5
Na^+ (8)	Dy^{3+} (8)	1.18	1.027	12.9
Mg^{2+} (6)	Dy^{3+} (8)	0.72	1.027	-42.6
V^{5+} (4)	Dy^{3+} (8)	0.355	1.027	-189

Table S2. Rietveld refinement and crystallographic parameters of $Sr_2NaMg_2V_3O_{12}: 0.01 Dy^{3+}$.

Formula	$Sr_{1.98}Na_{1.01}Dy_{0.01}Mg_2V_3O_{12}$					
Crystal system	Cubic					
Space group	$Ia\bar{3}d$ (230, O_h^{10})					
Cell Parameters	$a=12.652(2)$ Å, $V=2025.34$ Å ³					
Reliability factors	$R_{wp}=7.85\%$, $R_p=5.96\%$ and $GOF=1.64$					
Atom	Site	x	y	z	Occupancy	B_{eq} (Å ²)
Sr^{2+}	24c	0.375	0.5	0.25	0.65	0.009(8)
Dy^{3+}	24c	0.375	0.5	0.25	0.0167	0.009(8)
Na^+	24c	0.375	0.5	0.25	0.333	0.009(8)
Mg^{2+}	16a	0.50	0.50	0	1	0.007(5)
V^{5+}	24d	0.625	0.50	0.25	1	0.005(6)
O^{2-}	96h	0.042(3)	0.048(8)	0.653(6)	1	0.009(8)

Table S3. Rietveld refinement and crystallographic parameters of Sr₂NaMg₂V₃O₁₂: 0.03 Dy³⁺.

Formula	Sr _{1.94} Na _{1.03} Dy _{0.03} Mg ₂ V ₃ O ₁₂					
Crystal system	Cubic					
Space group	<i>Ia</i> $\bar{3}$ <i>d</i> (230, <i>O_h</i> ¹⁰)					
Cell Parameters	<i>a</i> =12.648(4) Å, <i>V</i> = 2023.52 Å ³					
Reliability factors	R _{wp} = 5.23%, R _p = 3.98 % and GOF= 1.23					
Atom	Site	x	y	z	Occupancy	B _{eq} (Å ²)
Sr ²⁺	24c	0.375	0.5	0.25	0.65	0.009(8)
Dy ³⁺	24c	0.375	0.5	0.25	0.0167	0.009(8)
Na ⁺	24c	0.375	0.5	0.25	0.333	0.009(8)
Mg ²⁺	16a	0.50	0.50	0	1	0.007(5)
V ⁵⁺	24d	0.625	0.50	0.25	1	0.005(6)
O ²⁻	96h	0.042(3)	0.048(8)	0.653(4)	1	0.009(8)

Table S4. Rietveld refinement and crystallographic parameters of Sr₂NaMg₂V₃O₁₂: 0.12 Dy³⁺.

Formula	Sr _{1.76} Na _{1.12} Dy _{0.12} Mg ₂ V ₃ O ₁₂					
Crystal system	Cubic					
Space group	<i>Ia</i> $\bar{3}$ <i>d</i> (230, <i>O_h</i> ¹⁰)					
Cell Parameters	<i>a</i> =12.622(6) Å, <i>V</i> = 2011.15 Å ³					
Reliability factors	R _{wp} = 5.95%, R _p = 4.61 % and GOF= 1.26					
Atom	Site	x	y	z	Occupancy	B _{eq} (Å ²)
Sr ²⁺	24c	0.375	0.5	0.25	0.65	0.009(8)
Dy ³⁺	24c	0.375	0.5	0.25	0.0167	0.009(8)
Na ⁺	24c	0.375	0.5	0.25	0.333	0.009(8)
Mg ²⁺	16a	0.50	0.50	0	1	0.007(9)
V ⁵⁺	24d	0.625	0.50	0.25	1	0.006(1)
O ²⁻	96h	0.039(3)	0.051(4)	0.655(1)	1	0.009(8)

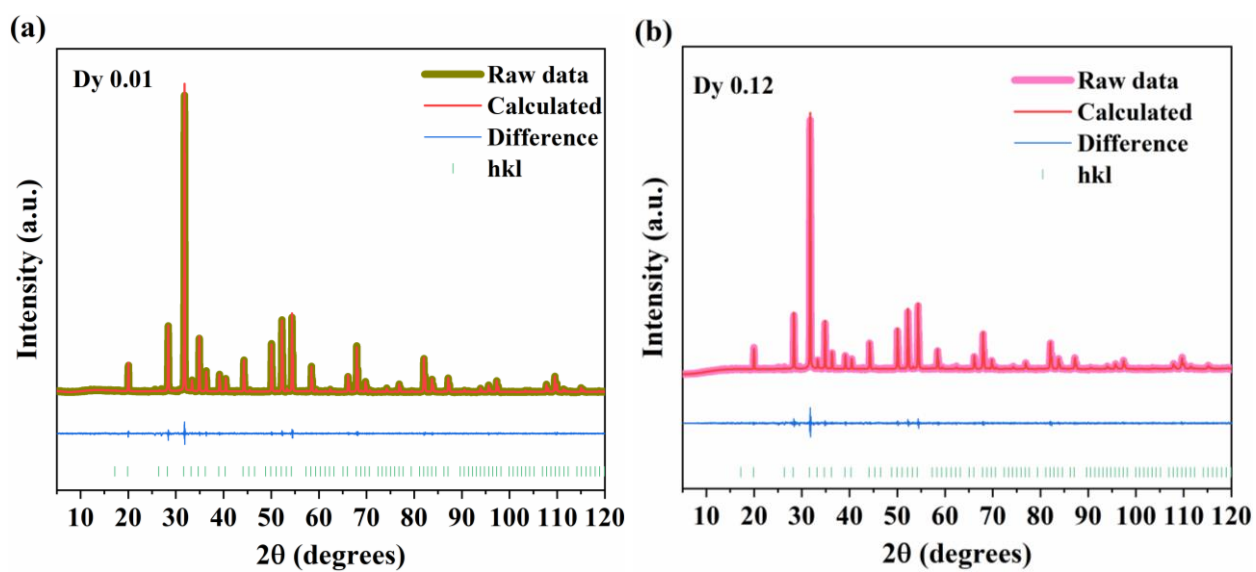


Fig. S1. Rietveld refinement pattern of (a) SNMV: 0.01 Dy³⁺ and (b) SNMV: 0.12 Dy³⁺.

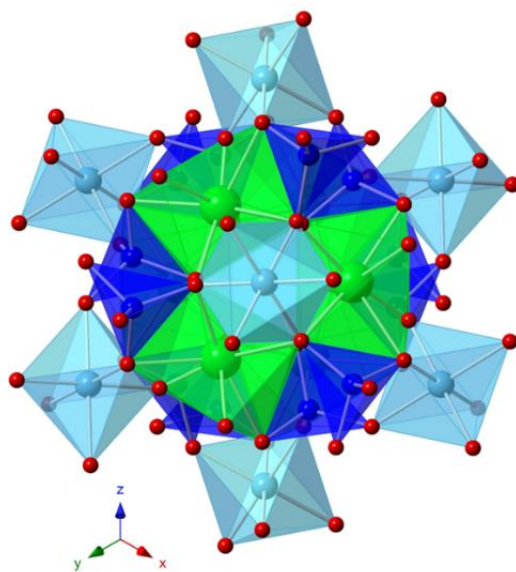


Fig. S2. The crystal structure viewed along [111] axis in which green, cyan, and blue polyhedra represent AO₈ (A= Sr/Na/Dy), MgO₆, and VO₄ configuration and red spheres represent oxygen ions.

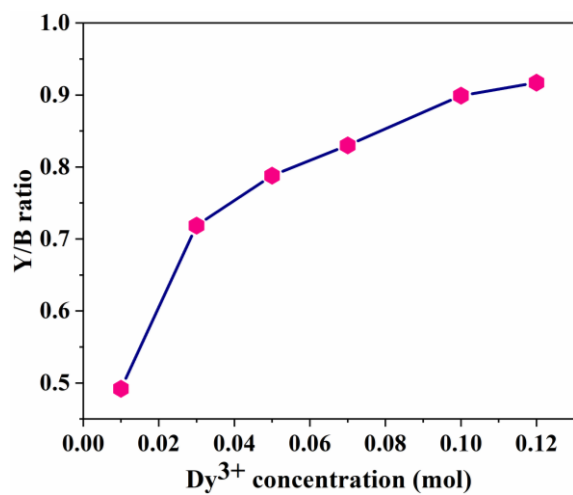


Fig. S3. The variation in the yellow to blue intensity ratio (Y/B) with concentration.

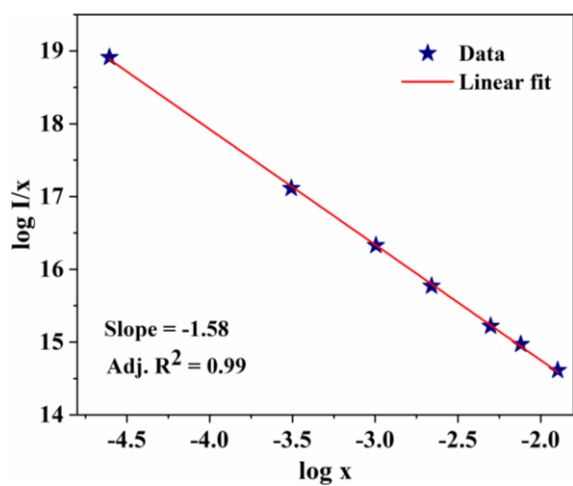


Fig. S4. The $\log(I/x)$ - $\log(x)$ plot for the transition of Dy³⁺ ions in Sr₂NaMg₂V₃O₁₂: Dy³⁺ phosphor.

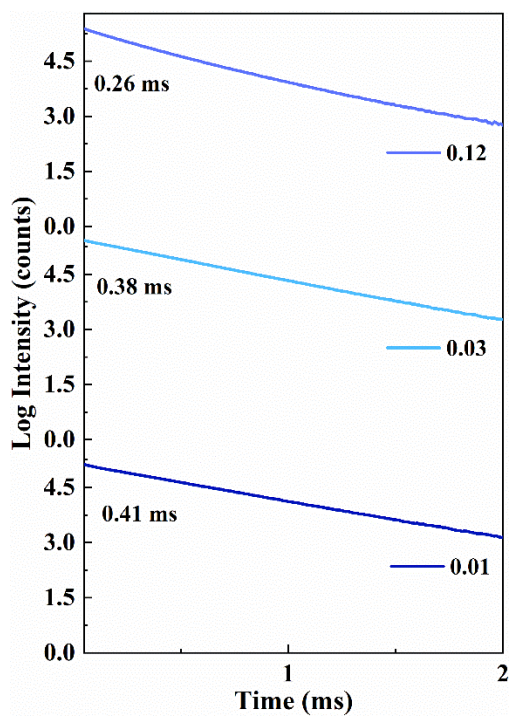


Fig. S5. The Decay curves of $\text{Sr}_2\text{NaMg}_2\text{V}_3\text{O}_{12}: x\text{Dy}^{3+}$ ($x=0.01, 0.03,$ and 0.12) phosphors.

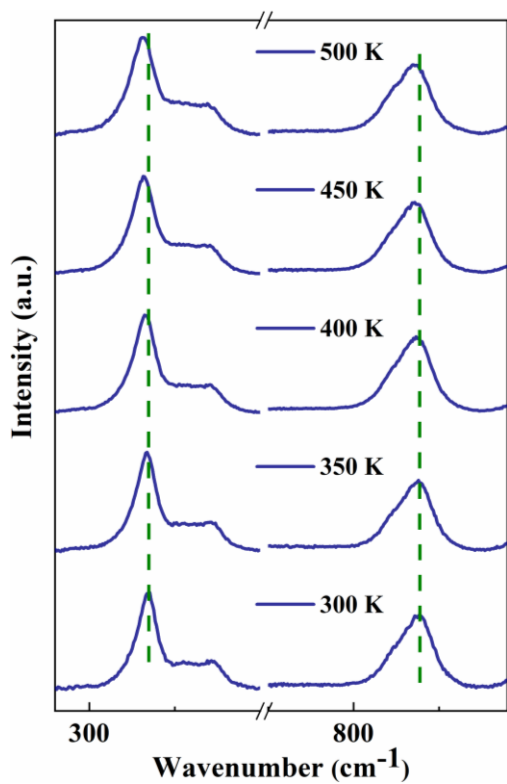


Fig. S6. Temperature-dependent Raman spectra of SNMV: 0.03 Dy^{3+} phosphor.

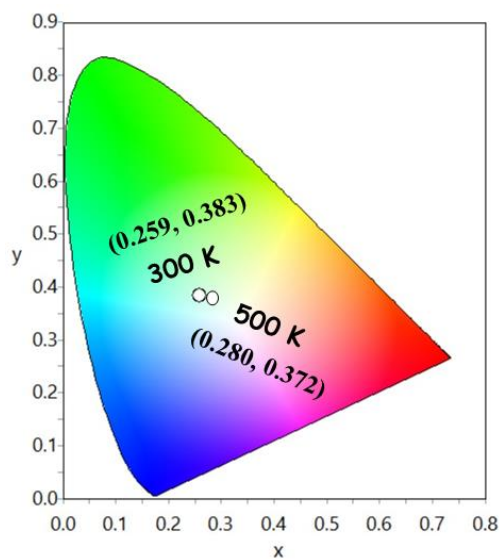


Fig. S7. CIE diagram showing the variation of emission color with temperature.

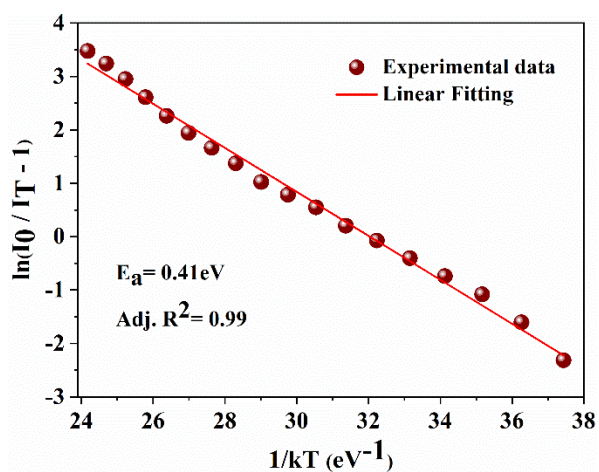


Fig. S8. Linear fit of the Arrhenius equation.