

Multi-mode Anti-counterfeiting Guarantees from a Single Material

CaCd₂Ga₂Ge₃O₁₂:Tb³⁺,Yb³⁺-Two Stimuli-responsive and Four-state Emission

Zhuobing Wang^{a,b,c}, Liwei Yang^a, Zhenbin Wang^{a,b,*}, Jiajia Cao^a, Cunhua Ma^{a,b}, Mingjin Zhang^{a,b},
Weisheng Liu^{a,b,c*}

^a School of Chemistry and Chemical Engineering, Qinghai Normal University, Xining 810008
China

^b Academy of Plateau Science and Sustainability, People's Government Of Qinghai Province &
Beijing Normal University, Xining, 810016, China

^c Key Laboratory of Nonferrous Metal Chemistry and Resources Utilization of Gansu Province
and State Key Laboratory of Applied Organic Chemistry, College of Chemistry and Chemical
Engineering, Lanzhou University, Lanzhou, 730000, China

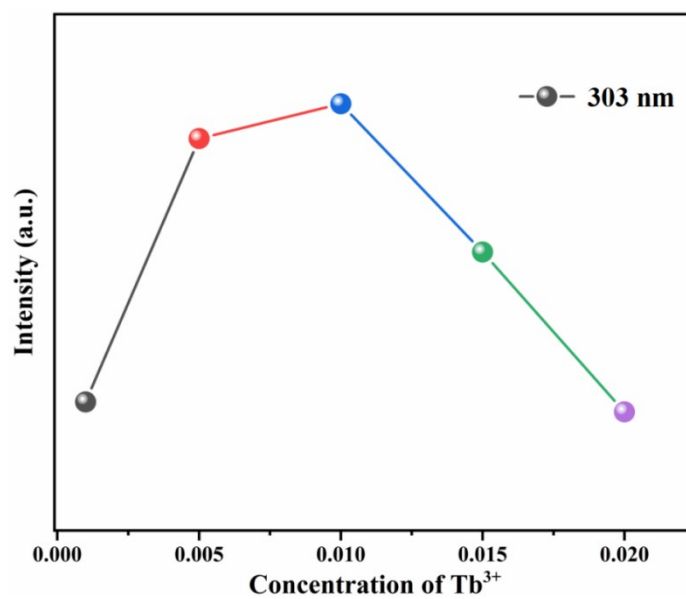
*Corresponding author: E-mail addresses:wangzhhqnu@163.com

liuws@lzu.edu.cn

Tel.: +86 / (0)971-5213524

Table S1 Crystal Data of CCGGO and CCGGO:0.01Tb³⁺,0.005Yb³⁺.

Crystal data		
Chemical formula	CCGGO	CCGGO:0.01Tb ³⁺ ,0.005Yb ³⁺
Crystal system	cuibc	cuibc
Space group	<i>Ia-3d</i> (230)	<i>Ia-3d</i> (230)
Unit cell dimensions	$a = b = c = 12.2050(4) \text{ \AA}$	$a = b = c = 12.2011(4) \text{ \AA}$
Volume	1818.08(3) \AA^3	1816.33(1) \AA^3
Z	8	8
R_{wp}	8.75%	11.23%
R_p	4.23%	6.79%
χ^2	1.94	1.97

**Fig.S1** Excitation intensity dependence on concentration of Tb³⁺.

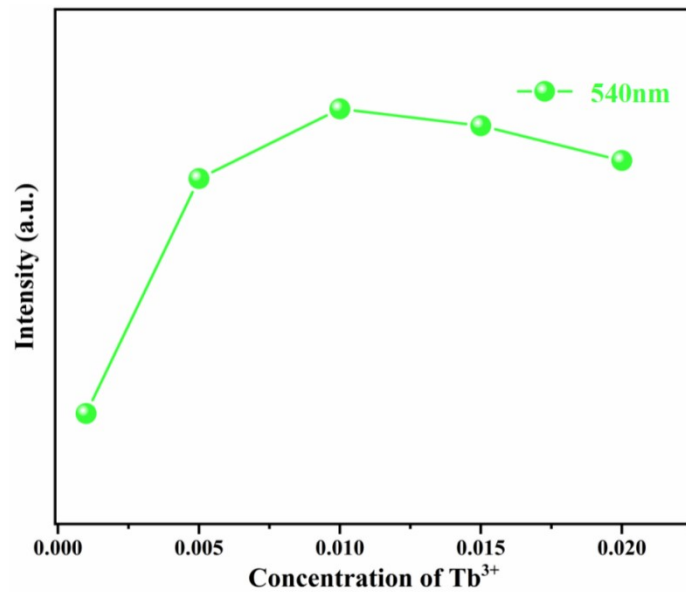


Fig.S2 Relative intensity for various concentration of Tb³⁺.

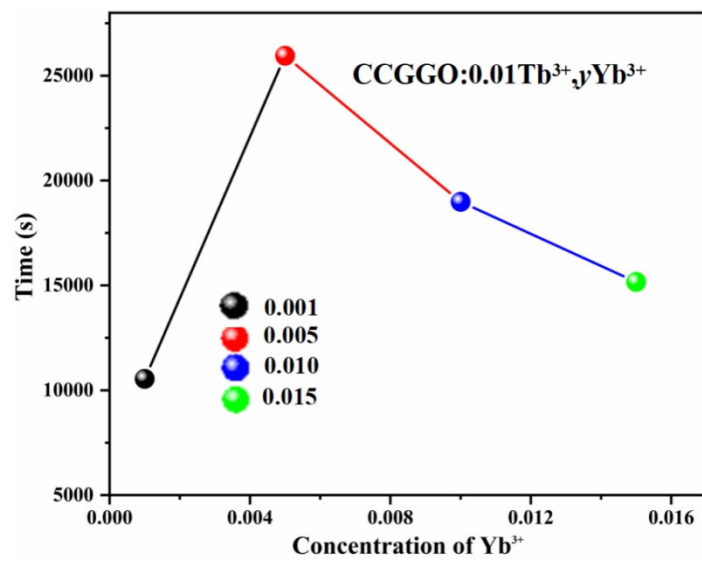


Fig.S3 The relative time for various concentration of Yb³⁺.

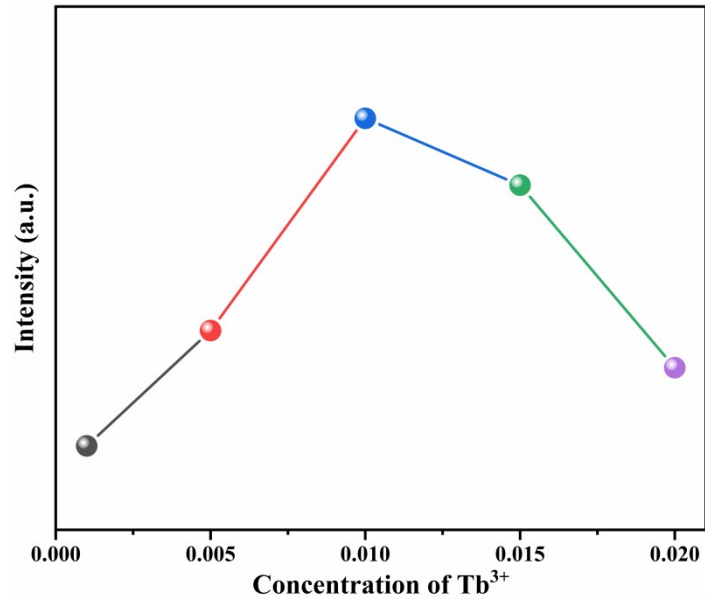


Fig.S4 Diagram of TL intensity versus Tb³⁺ doping concentration.

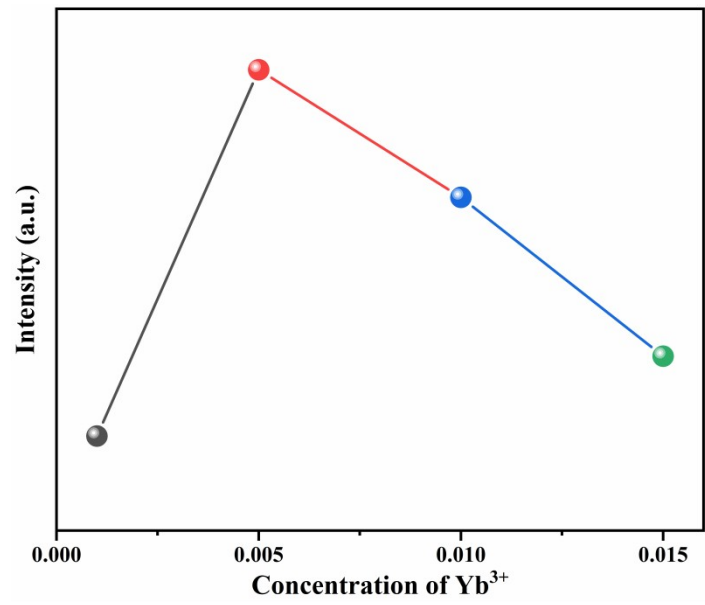


Fig.S5 The relative intensity for various concentration of Yb³⁺.