Electronic Supplementary Material (ESI) for Inorganic Chemistry Frontiers.

The direct identification of quantum cutting in Tm^{3+} ion and energy transfer in Tm^{3+}/Yb^{3+} system based on $Ba_2Gd_2Si_4O_{13}$ oxide host

Jia Zhang[a,b,*], Yuqing Pei[a], Chunlin Ma[a], Yining Zhang[a]

[a]Physics department and Jiangsu Key Laboratory of Modern Measurement Technology and Intelligence, Huaiyin Normal University, 111 West Chang Jiang Road, Huai'an 223300, China

[b]Jiangsu Key Laboratory for Chemistry of Low-Dimensional Materials, Huaiyin Normal University, 111 West Chang Jiang Road, Huai'an 223300, China

*Corresponding author.

E-mail address: zhangjianew@126.com

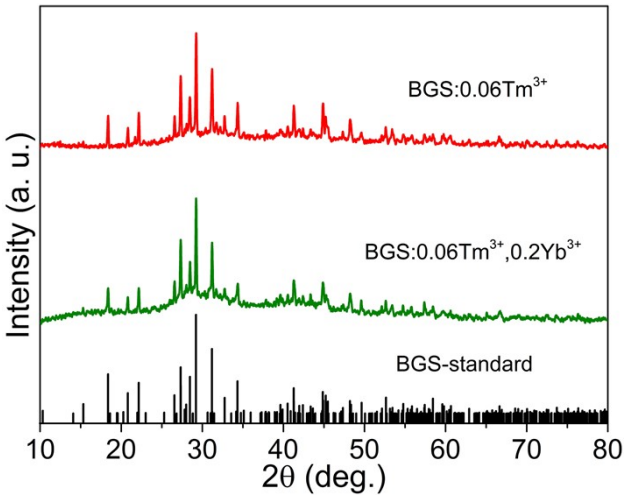

Figure S1 XRD patterns of BGS:0.06Tm^{3+} and BGS:0.06Tm^{3+},0.2Yb^{3+}

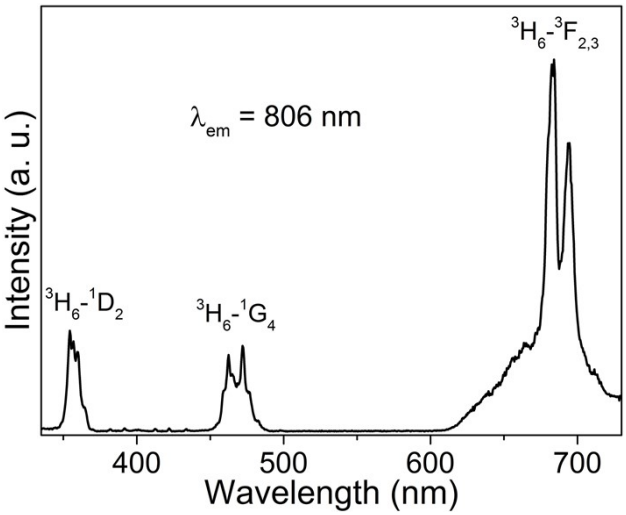

Figure S2 Excitation spectrum of BGS:0.06Tm^{3+} monitored at 806 nm

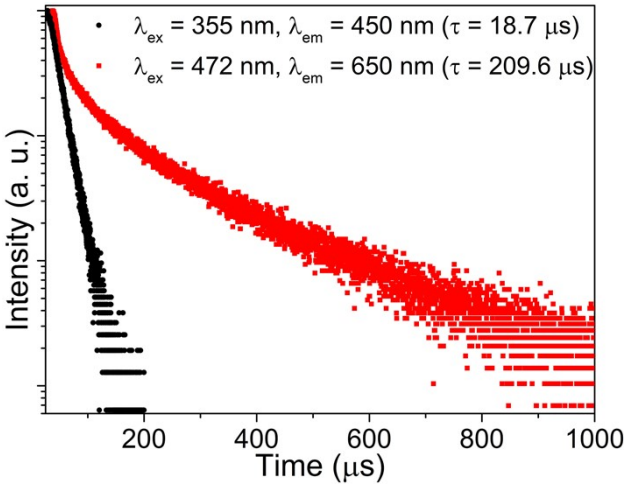

Figure S3 Decay curves of BGS:0.06Tm^{3+}

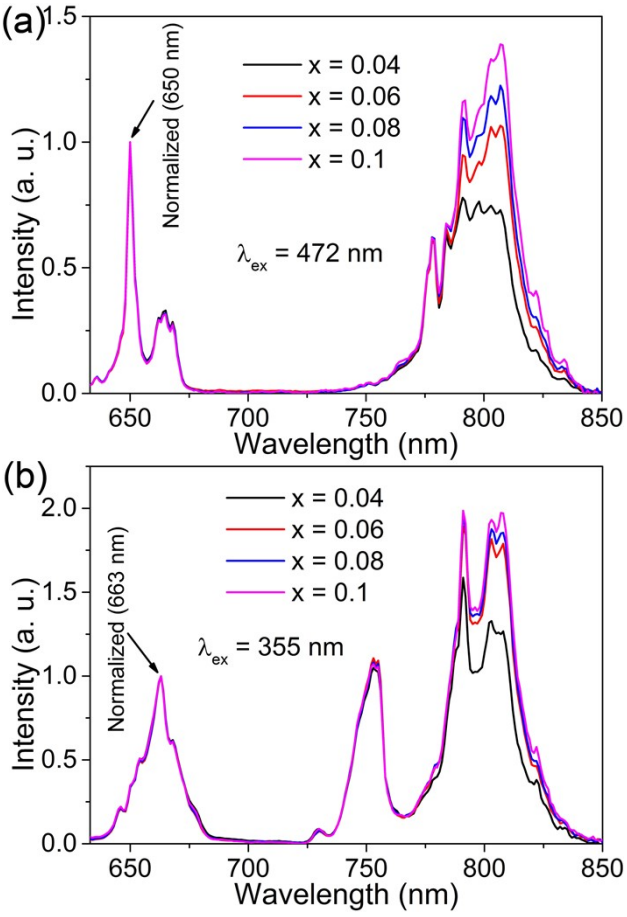

Figure S4 Normalized emission spectra of BGS:xTm^{3+} ($0.04 \leq x \leq 0.1$) under (a) 472 and (b) 355 nm excitation

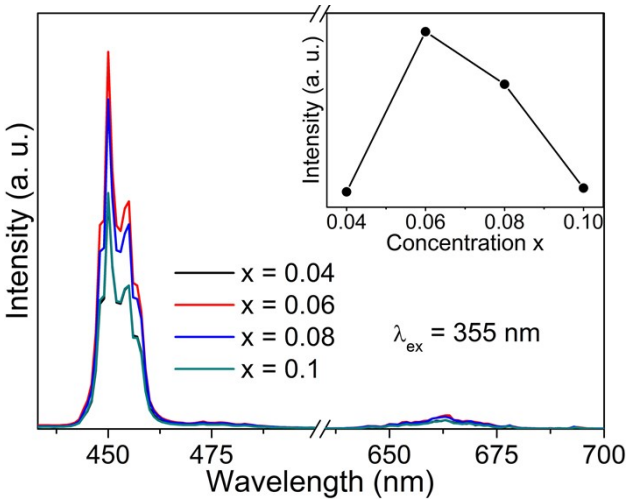

Figure S5 Emission spectra of BGS:xTm^{3+} ($0.04 \leq x \leq 0.1$) under 355 nm excitation, inset shows the dependence of 450 nm emission intensity on Tm^{3+} concentration

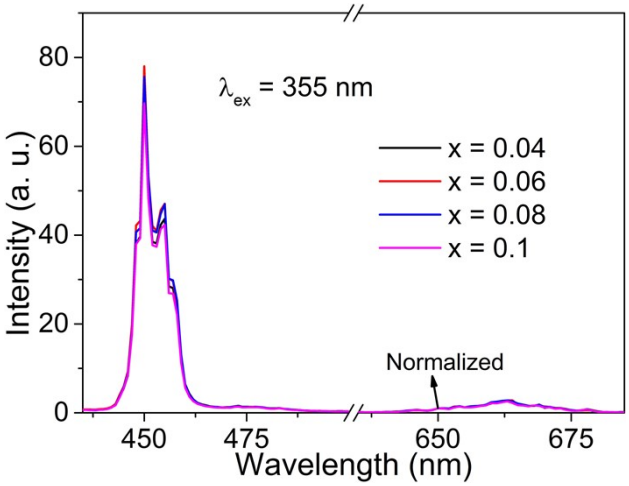

Figure S6 Normalized (for 650 nm) emission spectra of BGS:xTm^{3+} ($0.04 \leq x \leq 0.1$) under 355 nm excitation

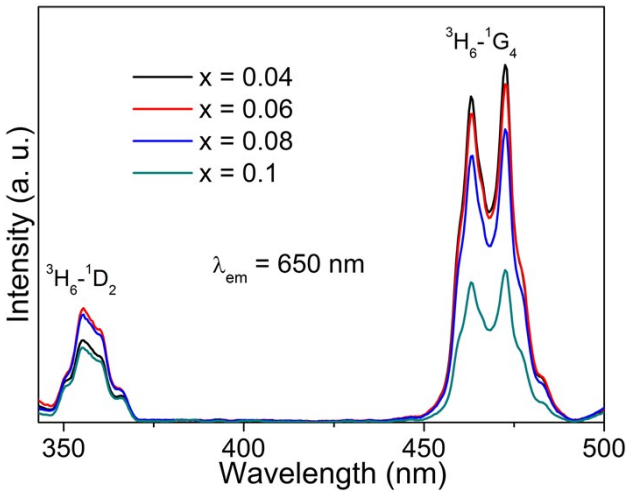

Figure S7 Excitation spectra of BGS:xTm^{3+} ($0.04 \leq x \leq 0.1$) monitored at 650 nm

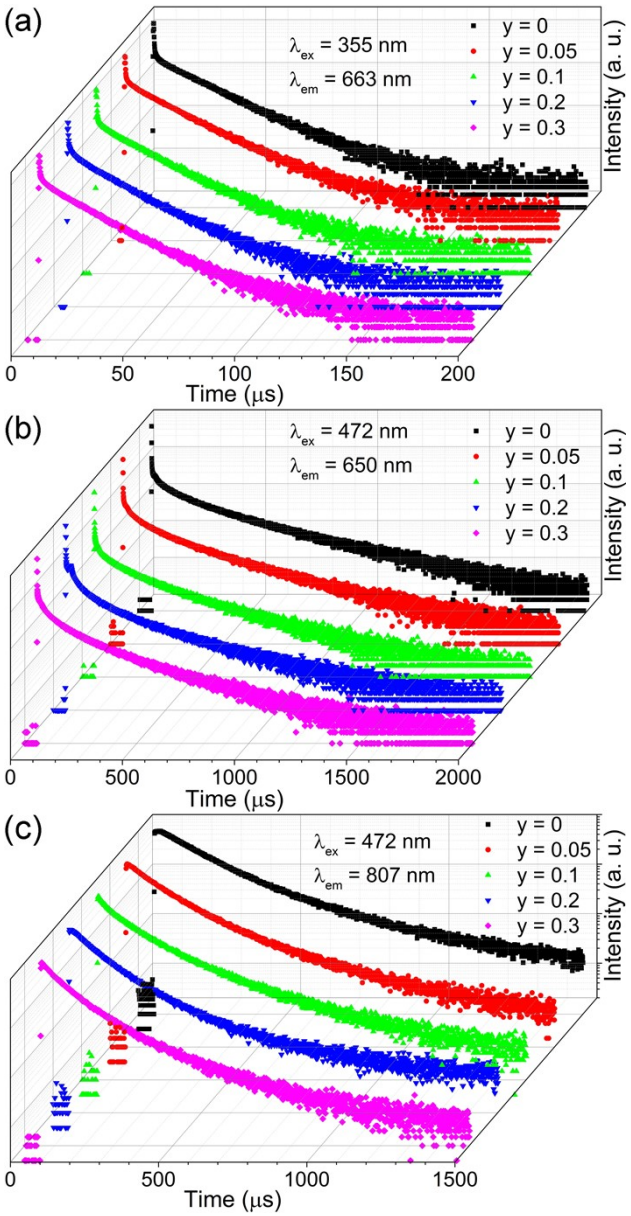

Figure S8 Decay curves of BGS:0.06Tm^{3+},yYb^{3+} ($0 \leq y \leq 0.3$) measured under different conditions: (a) λ_{ex} = 355 nm, λ_{em} = 663 nm; (b) λ_{ex} = 472 nm, λ_{em} = 650 nm; (c) λ_{ex} = 472 nm, λ_{em} = 807 nm

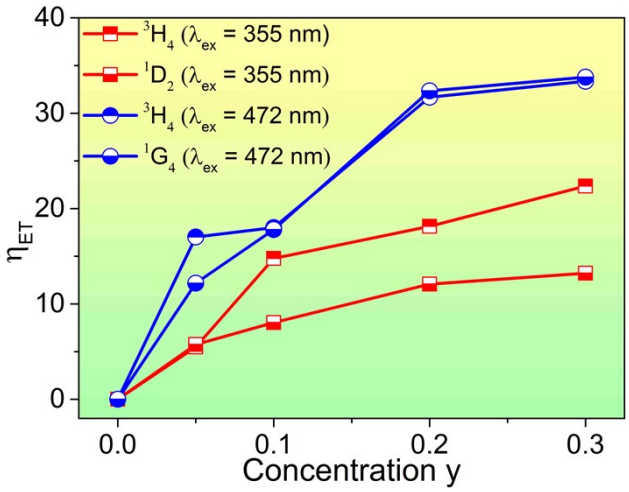

Figure S9 ET efficiencies (η_{ET}) of BGS:0.06Tm^{3+},yYb^{3+} ($0 \leq y \leq 0.3$) from different excited states of Tm^{3+} to Yb^{3+} excited by different wavelengths

Table S1 τ_i and B_i (i = 1, 2) values of the decay curves for BGS:0.06Tm^{3+}

λ_{ex} (nm)	λ_{em} (nm)	τ_1 (μs)	τ_2 (μs)	B_1	B_2
355	807	75.0	-	2648.0	-
472	807	115.5	301.2	7986.3	1363.6
683	807	71.2	-	1979.1	-
355	450	18.7	-	4213.8	-
472	650	209.6	-	2092.7	-

Table S2 τ_i and B_i (i = 1, 2) values of the decay curves for BGS:0.06Tm^{3+},yYb^{3+} ($0 \leq y \leq 0.3$) by exciting at 472 nm and monitoring 807 nm

y	τ_1 (μs)	τ_2 (μs)	B_1	B_2
0	115.5	301.2	7986.3	1363.6
0.05	90.7	242.9	7299.8	1438.3
0.1	75.2	214.0	5320.7	1717.2
0.2	76.7	210.7	7349.2	1193.0
0.3	70.2	197.4	6402.3	1241.1