Supporting Information

Investigation of high concentration doping performance based on Er^{3+} ions doped $Ba_6Gd_2Ti_4O_{17}$

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1. Experimental Section

1.1 Synthesis of the Y_2O_3: $0.1Yb^{3+}/0.25Er^{3+}$ phosphor

Firstly, the stoichiometric amount of rare earth nitrate stock solutions ($Y(NO_3)_3$ of 0.5_M, $Yb(NO_3)_3$ of 0.1_M, $Er(NO_3)_3$ of 0.05_M) was mixed and stirred. Then, citric acid as a chelating agent was add to the mixture at a molar ratio of [citric acid]/[metal]=1:2. After forming a transparent solution, the mixture was dried at 120 ℃ for 10 h. The obtained gel was

calcined at 500 ℃ for 2h and then calcined at 1200 ℃ for 4h.

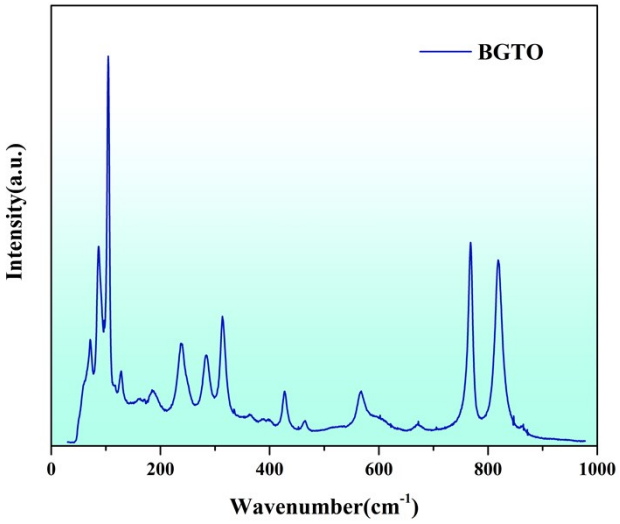

Figure S1. Raman spectrum of BGTO host.

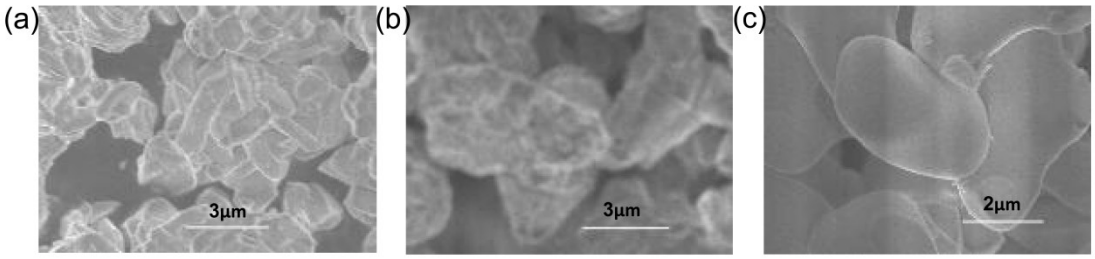

Figure S2. SEM images of the as-synthesized Yb^{3+}/Er^{3+} co-doped (a) BGTO, (b) BGO and (c) BGZO phosphors.

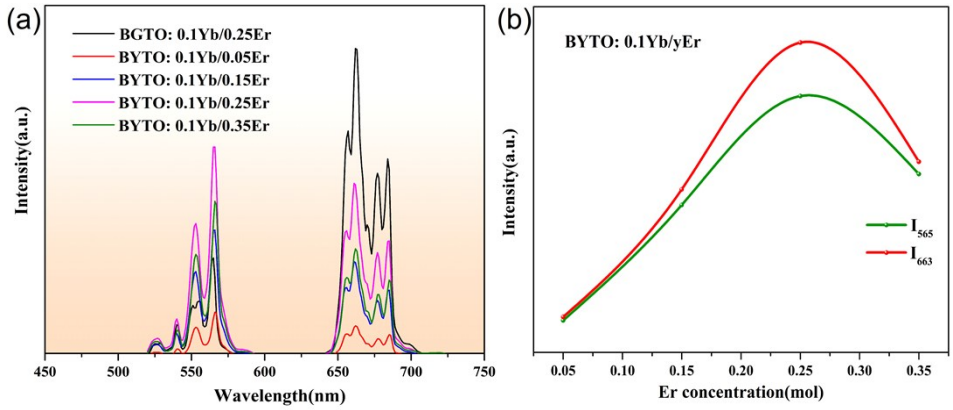

Figure S3. (a) UC emission spectra of BGTO: $0.1Yb^{3+}/0.25Er^{3+}$ and BYTO: $0.1Yb^{3+}/yEr^{3+}$ (y=0.05, 0.15, 0.25, 0.35) along with (b) the line chart.

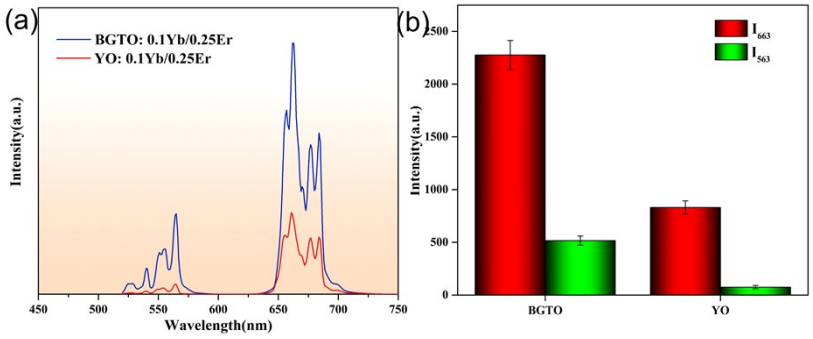

Figure S4. (a) Typical UC luminescence spectra of the BGTO: $0.1Yb^{3+}/0.25Er^{3+}$ phosphor and Y_2O_3: $0.1Yb^{3+}/0.25Er^{3+}$ and (b) the average values of three measurements.

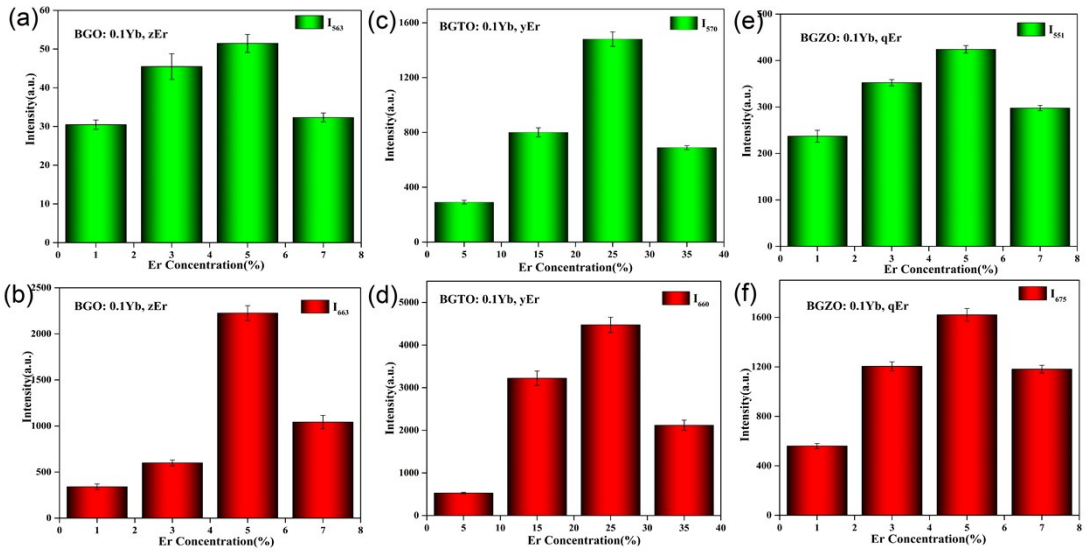

Figure S5. Emission intensities with different Er^{3+} concentration of (a)-(b) BGO: $0.1Yb^{3+}/zEr^{3+}$ (c)-(d) BGTO: $0.1Yb^{3+}/yEr^{3+}$ and (e)-(f) BGZO: $0.1Yb^{3+}/qEr^{3+}$ (the average values of three measurements).

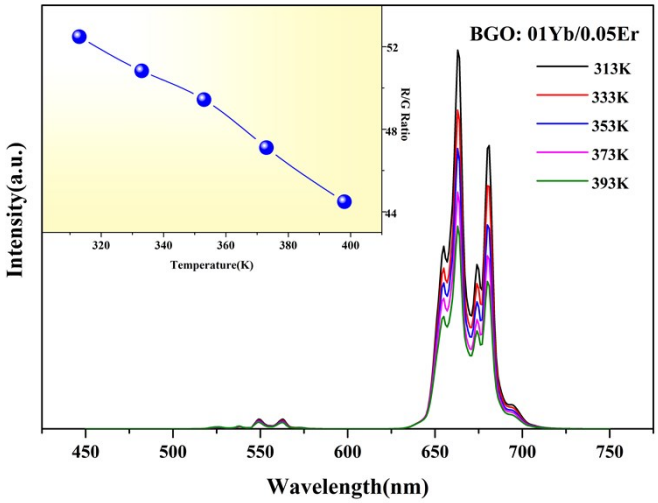

Figure S6. The emission spectra of BGO: $0.1Yb^{3+}/0.05Er^{3+}$ and the R/G ratio at different temperatures.

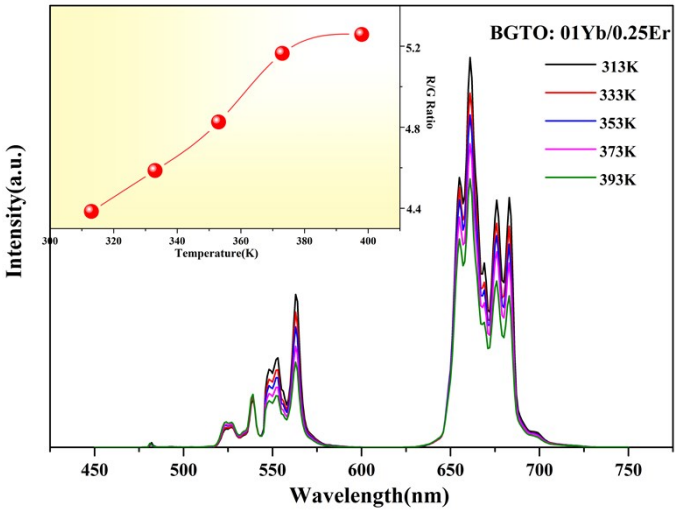

Figure S7. The emission spectra of BGTO: 0.1Yb^{3+}/0.25Er^{3+} and the red-green ratio at different temperatures.

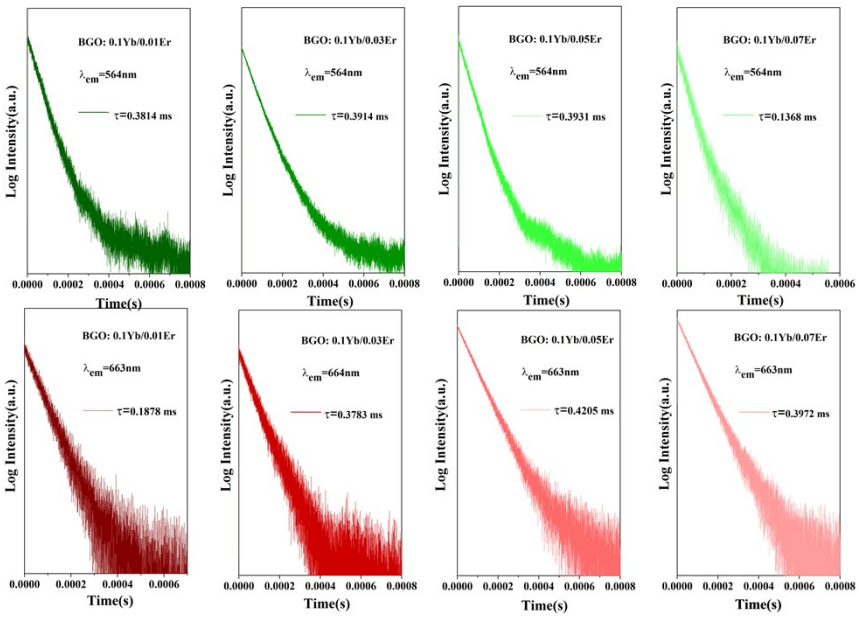

Figure S8. Decay curves of the (a)-(d) $^4S_{3/2}\rightarrow{}^4I_{15/2}$ and (e)-(h) $^4F_{9/2}\rightarrow{}^4I_{15/2}$ transition in BGO: 0.1Yb^{3+}/zEr^{3+} (y=0.01-0.07) under 980nm excitation.

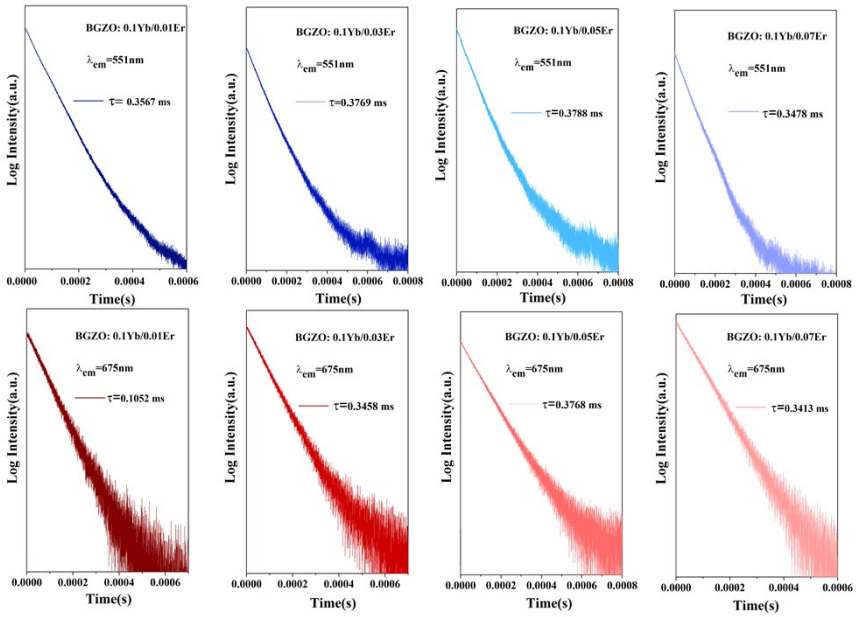

Figure S9. Decay curves of the (a)-(d) $^4S_{3/2}\rightarrow{}^4I_{15/2}$ and (e)-(h) $^4F_{9/2}\rightarrow{}^4I_{15/2}$ transition in BGZO: 0.1Yb^{3+}/qEr^{3+} (y=0.01-0.07) under 980nm excitation.

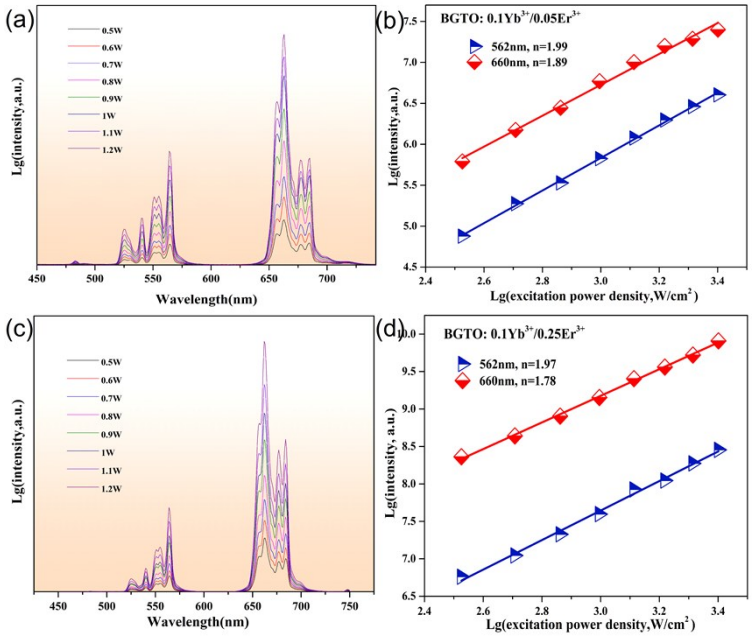

Figure S10. (a), (c) The luminescence spectra at different excitation powers of the BGTO: 0.1Yb^{3+}/0.05Er^{3+} and 0.1Yb^{3+}/0.25Er^{3+} phosphors. (b), (d) The corresponding relationship of red and green UC luminescence intensity versus excitation power density from a 980 nm

laser.

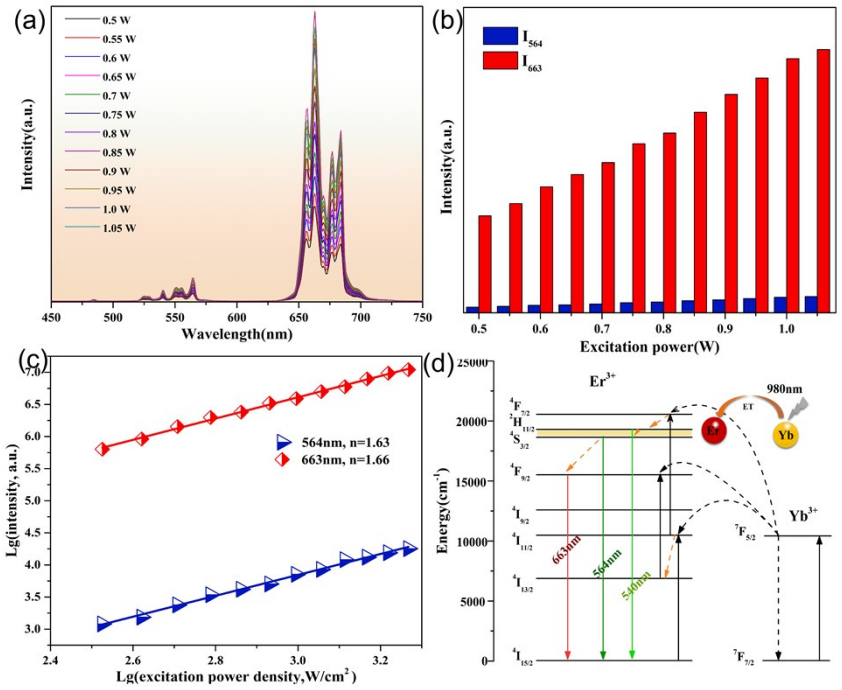

Figure S11. (a)-(b) The emission spectra and histogram at different excitation powers of the BGO: $0.1Yb^{3+}/0.05Er^{3+}$ phosphor. (c) The relationship of red and green UC luminescence intensity versus excitation power from a 980 nm laser for the BGO: $0.1Yb^{3+}/0.05Er^{3+}$ phosphor. (d) The energy level diagram of Yb^{3+}/Er^{3+} and the possible energy transfer mechanisms.

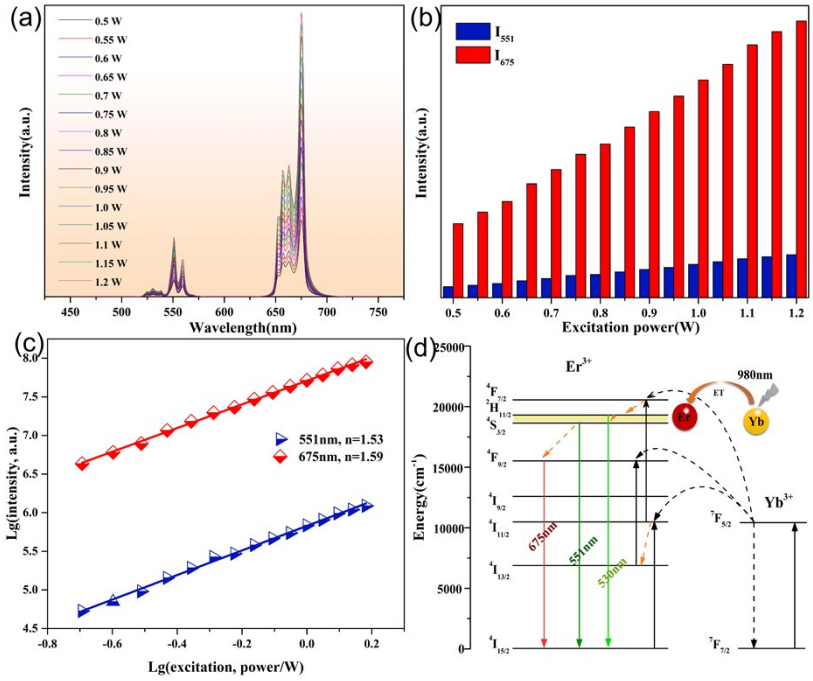

Figure S12. (a)-(b) The emission spectra and histogram at different excitation powers of the BGZO:0.1Yb^{3+}/0.05Er^{3+} phosphor. (c) The relationship of red and green UC luminescence intensity versus excitation power from a 980 nm laser for the BGZO: 0.1Yb^{3+}/0.05Er^{3+} phosphor. (d) The energy level diagram of Yb^{3+}/Er^{3+} and the possible energy transfer mechanisms.