Electronic Supplementary Material (ESI) for Physical Chemistry Chemical Physics.

Supporting Information

Power-dependent photophysical pathway of upconversion in $BaTiO_3:Er^{3+}$

Hyeongyu Bae[†], *Eunsang Lee*[†] and *Kang Taek Lee**

Department of Chemistry, Gwangju Institute of Science and Technology, Cheomdangwagi-ro 123, Buk-gu, Gwangju, Republic of Korea

E-mail : ktlee@gist.ac.kr (Kang Taek Lee)

Experimentals

Synthesis of Er^{3+} doped BT : Barium carbonate (≥99%), titanium(IV) oxide (99.8%), sodium chloride (99.5%), and erbium oxide (99.99%) were purchased from Sigma-Aldrich and were used as received. Stochiometric amount of source reagents (Table S1) were ground for 1 hour with agate-mortar and agate-pestle. After that, reagents were sintered at 1100 ^{o}C for 5 hours. The as-prepared sample was washed by water and dried for 12 hours at 80 ^{o}C. Products were polycrystalline BT with little pinky color.

Characterization of Er^{3+} doped BT: Characterization of structure and morphology were gathered by an X-ray diffractometer (XRD, X'Pert PRO Multi-Purpose X-Ray Diffractometer, PANalytical) with Cu Kα radiation and transmission electron microscope (TEM, Tecnai G2 F30 S-Twin, FEI), respectively. diffuse reflectance (DR) measurement was conducted using a UV-Vis-NIR spectrometer (LAMBDA 950, Perkin Elmer).

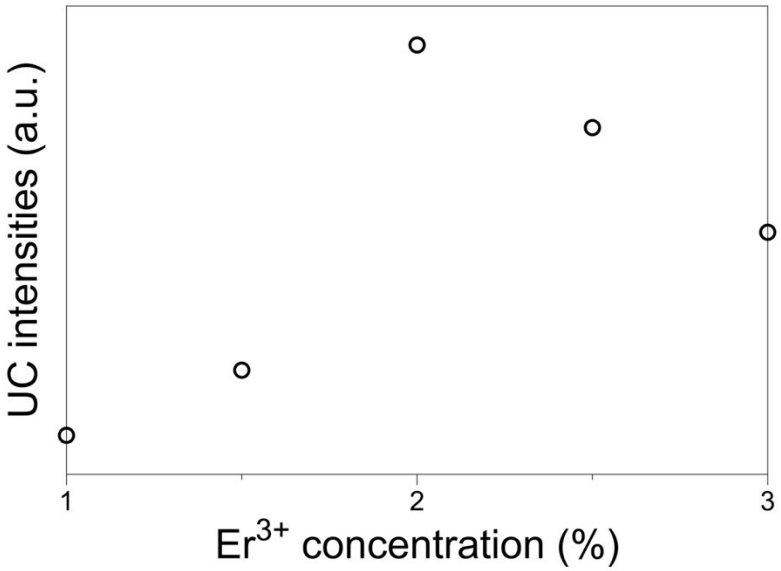

Figure S1. UC intensities vs. Er^{3+} concentration plot of x% Er^{3+}-doped BT (x:1, 1.5, 2, 2.5, 3).

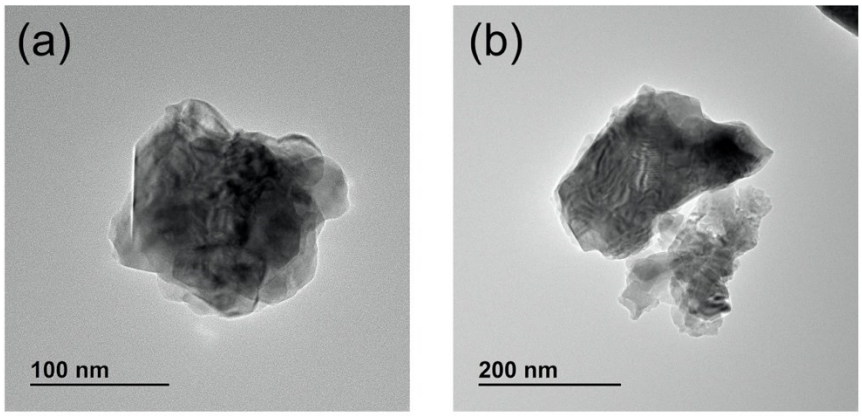

Figure S2. TEM images of E-BT.

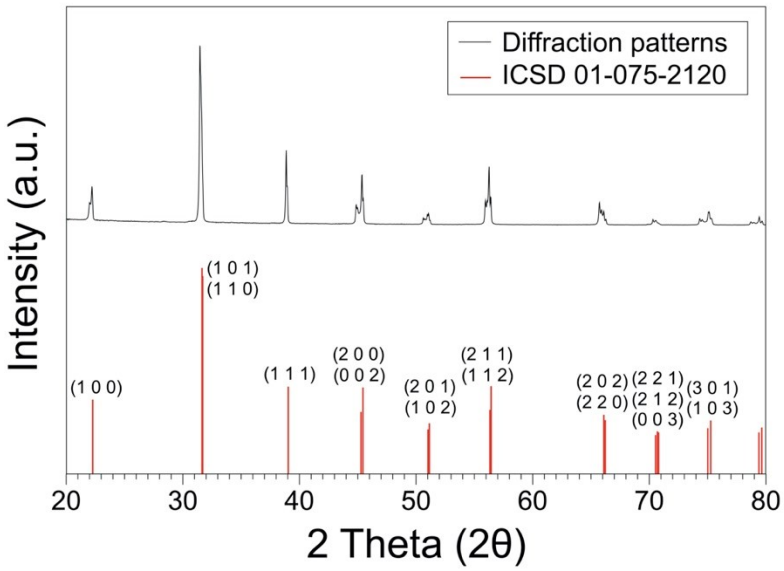

Figure S3. X-ray diffraction patterns of E-BT (reference patterns: ICSD 01-075-2120).

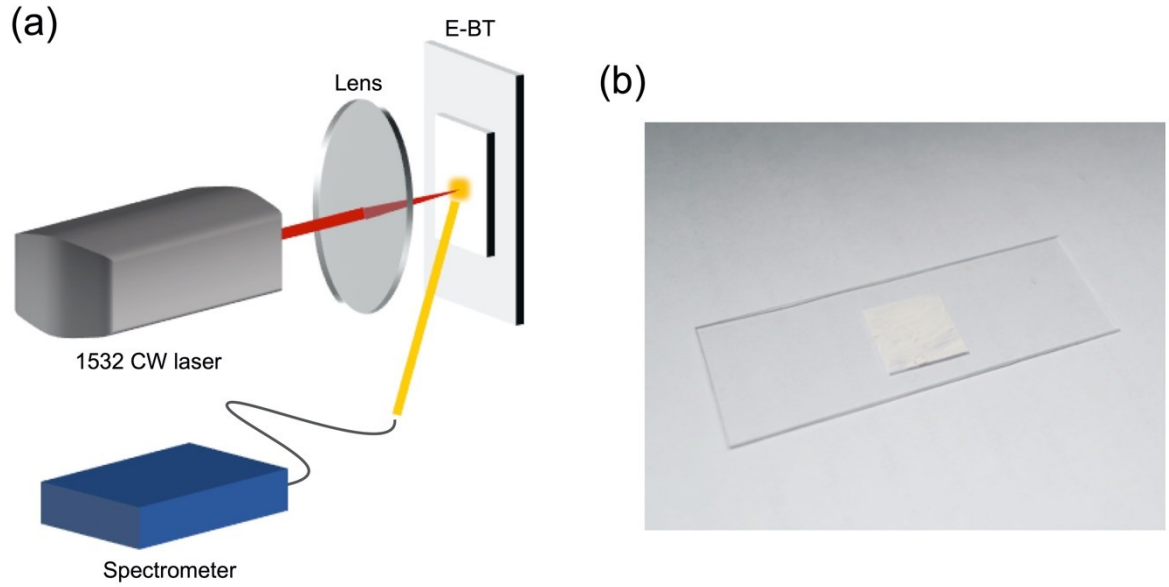

Figure S4. (a) Illustrative figures of optical setup, and (b) photographs of E-BT on glass substrate.

Table S1. Table for the stoichiometric amounts needed for solid-state reaction of E-BT.

Host Crystal	Dopant Ions	Ion concentration	Molar percent (mol%)			
			$BaCO_3$	TiO_2	Er_2O_3	NaCl
$BaTiO_3$	Er^{3+}	1 %	0.99	1	0.005	1
$BaTiO_3$	Er^{3+}	1.5 %	0.985	1	0.0075	1
$BaTiO_3$	Er^{3+}	2 %	0.98	1	0.01	1
$BaTiO_3$	Er^{3+}	2.5 %	0.975	1	0.0125	1
$BaTiO_3$	Er^{3+}	3 %	0.97	1	0.015	1