Electronic Supplementary Information

Tuning the Upconversion Light Emission by Bandgap Engineering in Bismuth Oxide-based Upconverting Nanoparticles

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Table S1 Summary of the parameters obtained from Rietveld refinement of the samples.

	Cubic phase			Tetragonal phase						
Sample	a	V_{cell}	wt%	a	c	$V_{cell}/2$	wt%	R_p	R_{wp}	GOF
Y0Er2	-	-	-	7.748	5.639	169.25883	100	8.91	11.78	1.59
Y4Er2	-	-	-	7.7684	5.65315	170.57852	100	8.11	10.25	1.45
Y7Er2	5.53403	169.48237	44.82	7.77896	5.63469	170.48354	55.18	8.37	11.05	1.60
Y10Er2	5.52848	168.97278	84.19	7.77605	5.63315	170.30976	15.81	7.34	9.40	1.38
Y12Er2	5.52534	168.68512	86.98	7.77903	5.6299	170.34194	13.02	6.96	8.94	1.30
Y15Er2	5.51516	167.75429	96.75	7.779	5.63	170.34365	3.25	7.13	9.24	1.39
Y20Er2	5.5008	166.44761	100	-	-	-	-	7.07	9.09	1.31
Y30Er2	5.467	163.39812	100	-	-	-	-	6.64	8.77	1.41
Y40Er2	5.45	161.87863	100	-	-	-	-	8.05	11.66	1.84

GOF= goodness of fit

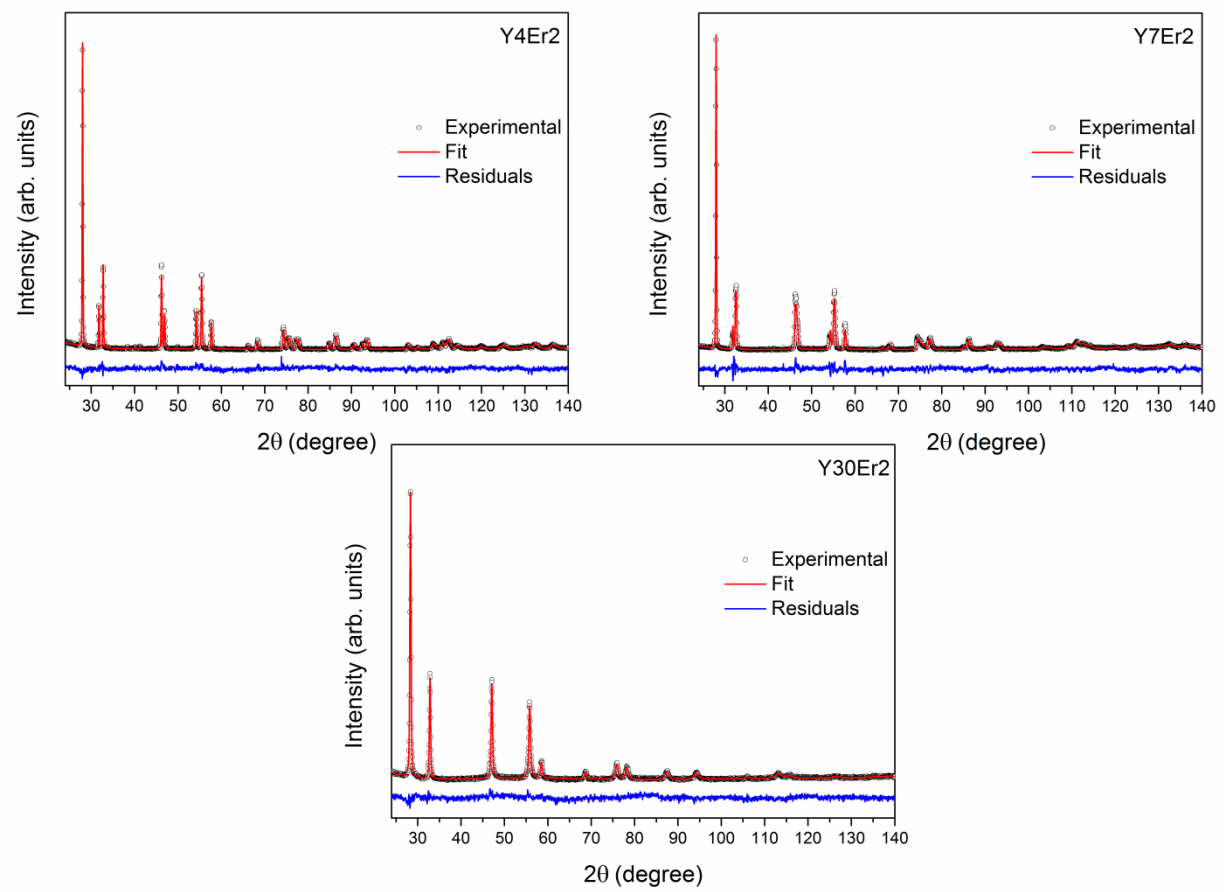

Fig. S1 Rietveld refinement fit performed on Y4Er2, Y7Er2 and Y30Er2 samples. The fit of the XRPD spectrum of Y30Er2 sample (cubic phase), can be performed considering a cubic cell (space group Fm3m) with a=5.5008. However, the same spectrum can be obtained by fitting with a tetragonal cell (space group P421c) with a=7.7800 and c=5.5003, refining the atomic position with very small variations.

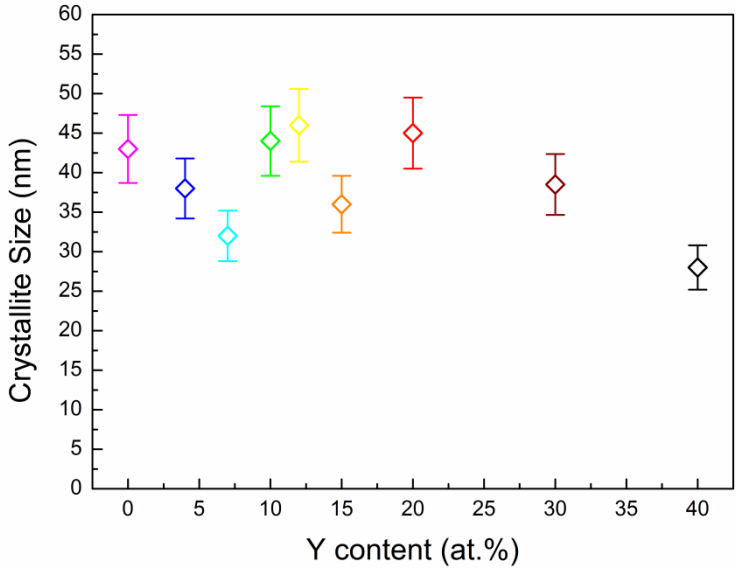

Fig. S2 Average crystallite size of Bi_2O_3-based NPs estimated by Scherrer analysis as a function of the Y content.

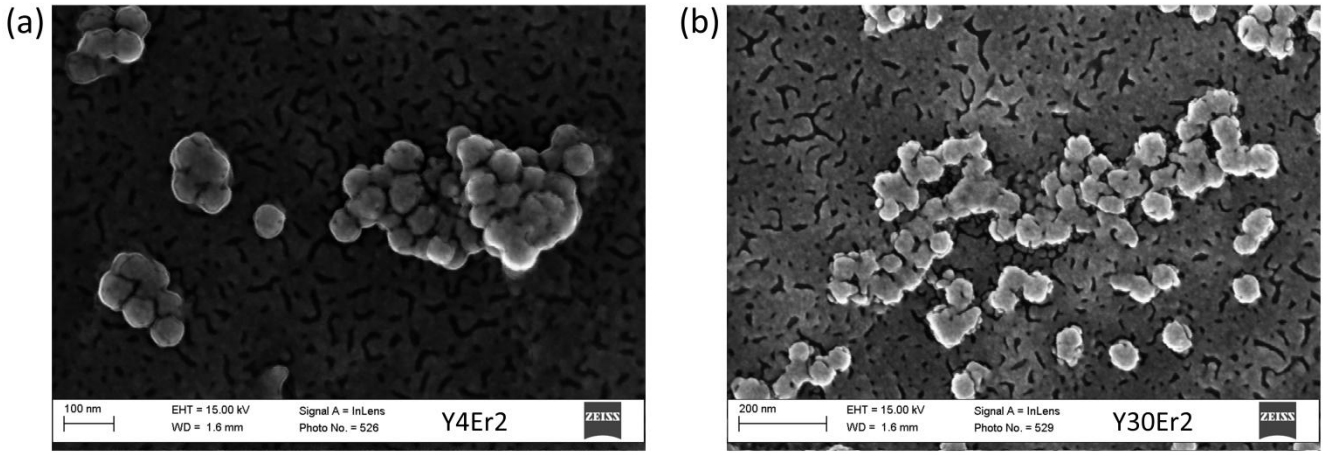

Fig. S3 FE-SEM images of (a) Y4Er2 and (b) Y30Er2 samples.

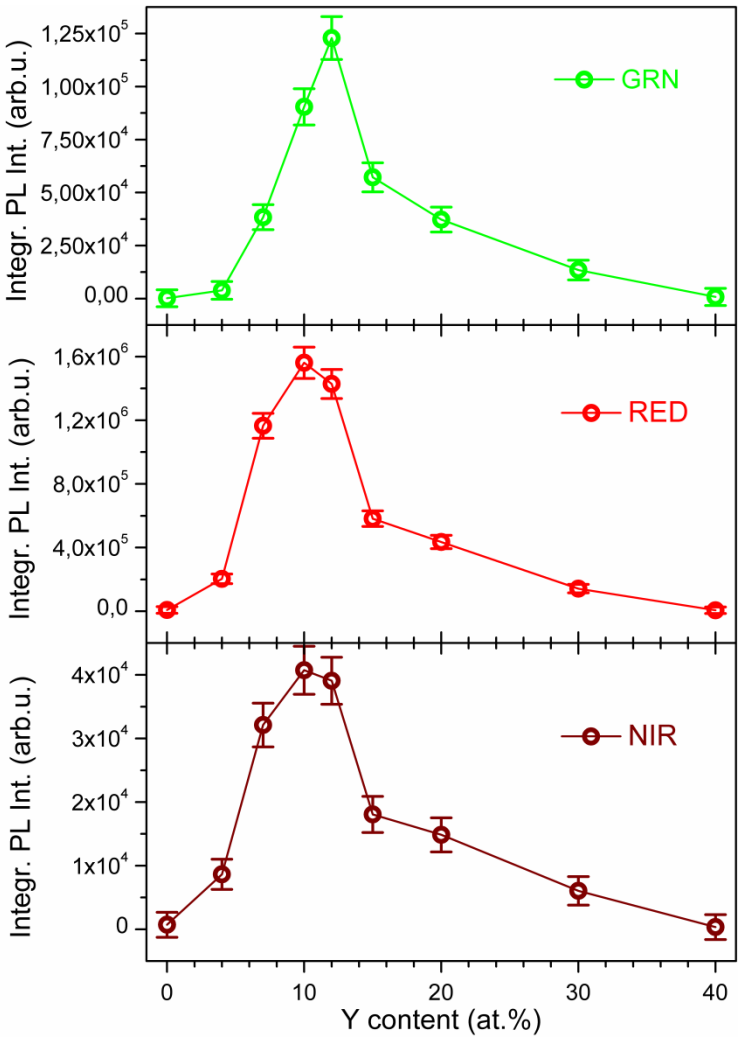

Fig. S4 Trend of integrated PL intensity for the GRN, RED and NIR transitions versus Y content with original, non-normalized values; sample excitation at 980 nm.

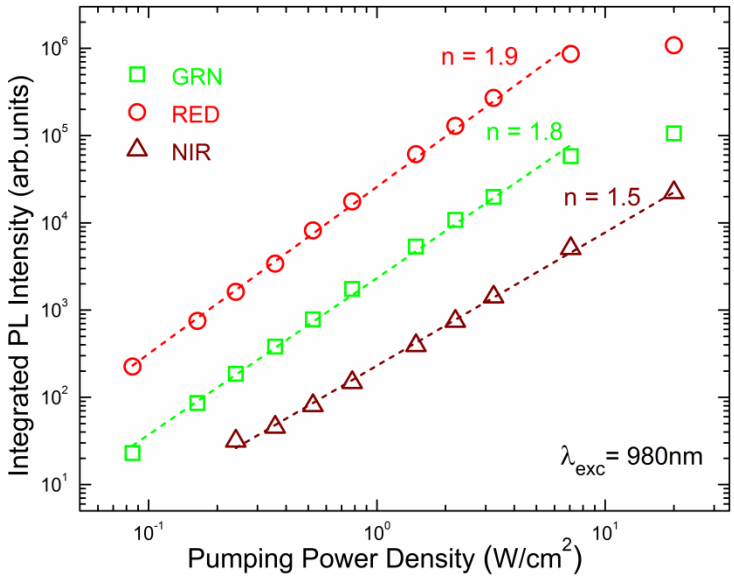

Fig. S5 Double-log-plot of the integrated UC PL intensity of the GRN, RED and NIR emissions versus pumping power density of the 980 nm laser diode excitation source and the corresponding order (n) of the UC process. Measurements were done on Y10Er2 sample.

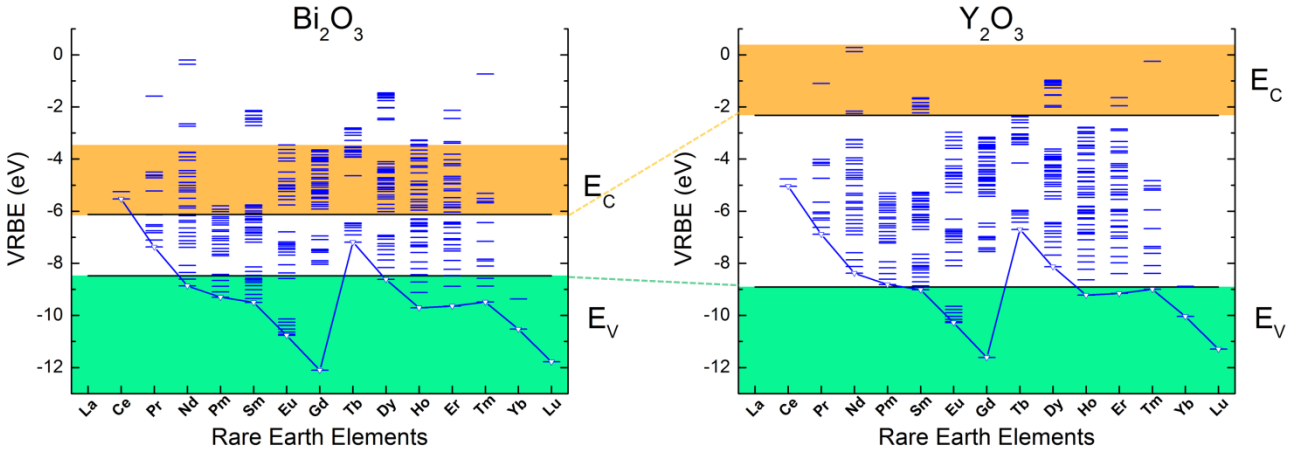

Fig. S6 VRBE diagrams of lanthanide ions in Bi_2O_3 and Y_2O_3.