

Supporting Information

Nondestructive up-conversion readout in Er/Yb co-doped $\text{Na}_{0.5}\text{Bi}_{2.5}\text{Nb}_2\text{O}_9$ -based optical storage materials for optical data storage device applications

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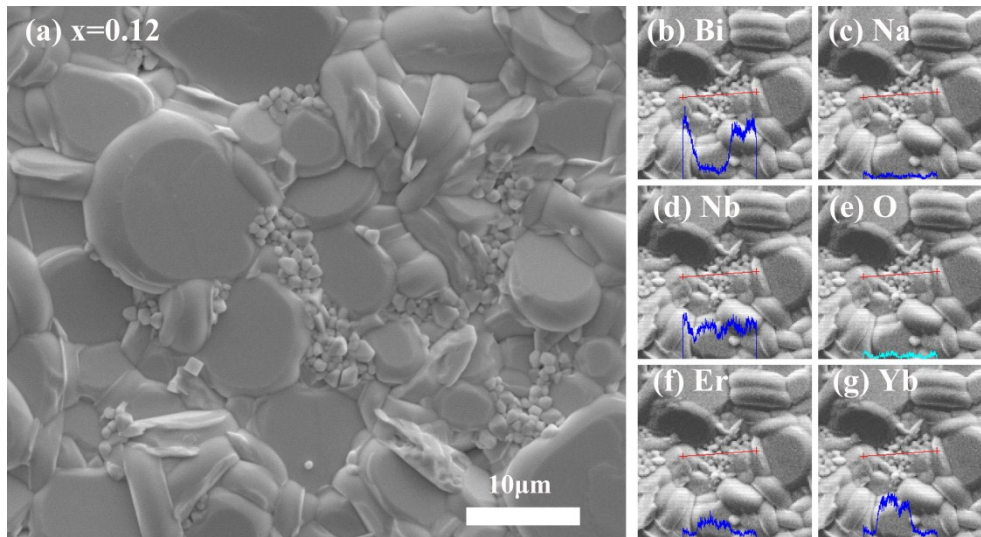


Fig. S1 SEM image and line scanning results of different elements for the ceramic sample

($x=0.12$).

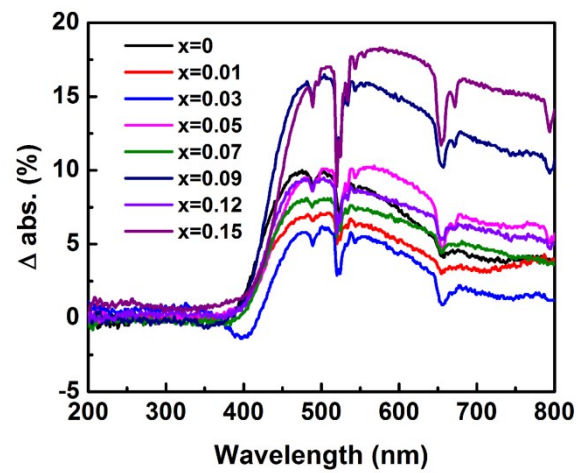


Fig. S2 The difference ($\Delta \text{abs.}$) between reflectance ratios of NBEN: x Yb samples before and after 407 nm light irradiation (LD, 200 mW).

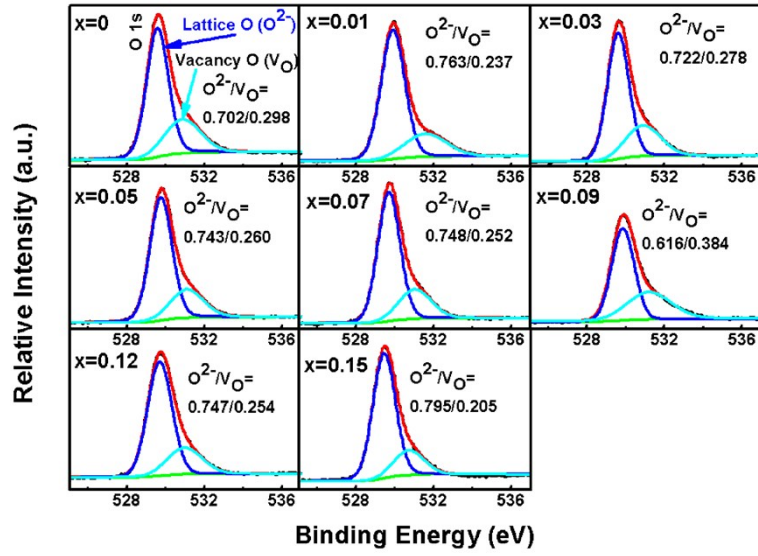


Fig. S3 O 1s XPS spectra and fitting data of NBN-based ceramic samples with different Yb³⁺ concentrations

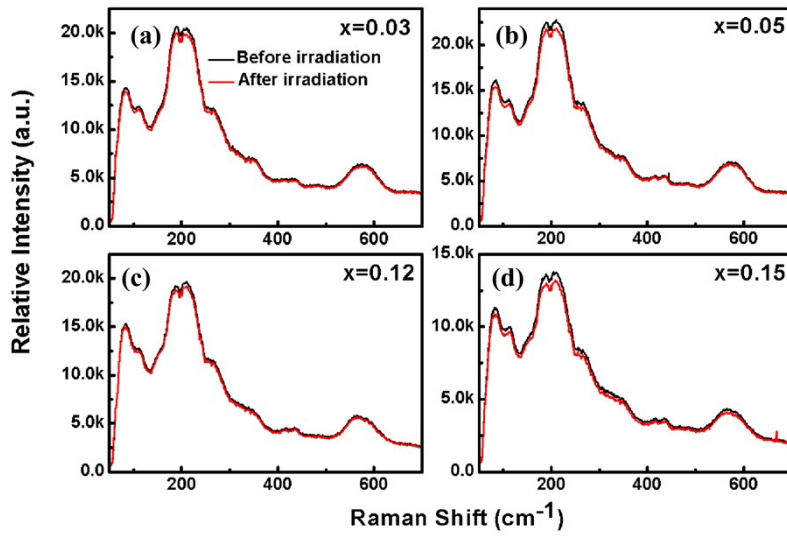


Fig. S4 Raman spectra of NBN:xYb (x=0.03, 0.05, 0.12, and 0.15) samples before and after 407 nm light irradiation (LD, 200 mW) for 10 s.

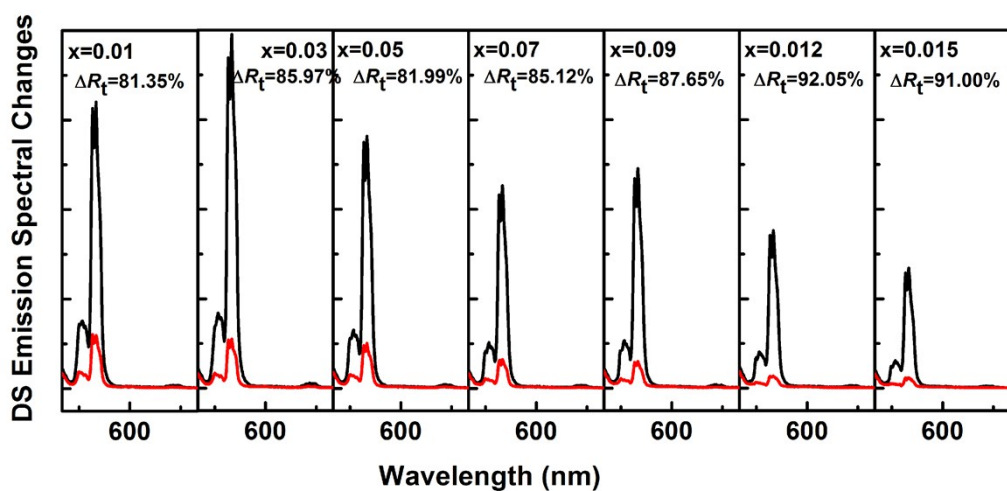


Fig. S5 DS emission spectra ($\lambda_{\text{ex}}=487$ nm) of NBEN:xYb samples before and after 407 nm light (LD, 200 mW) irradiation for 10 s.

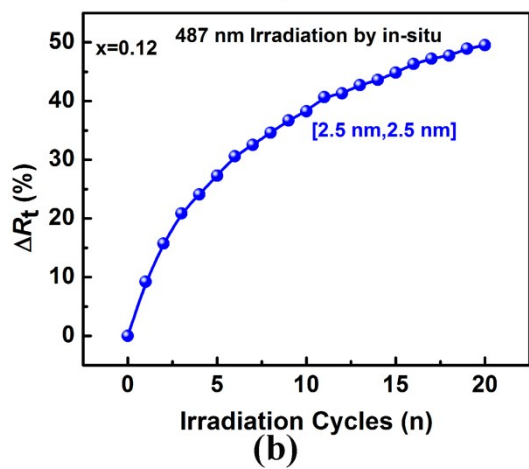
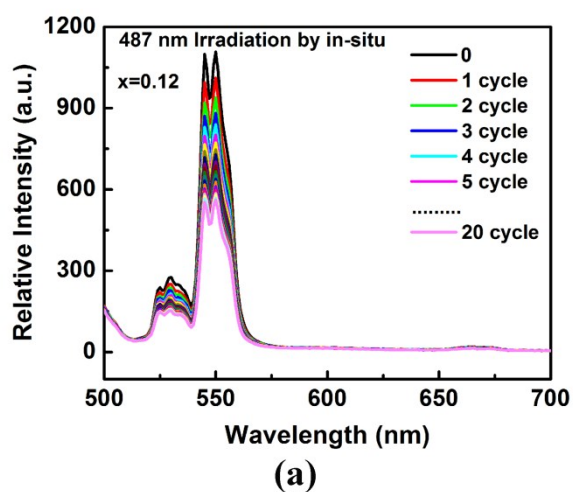


Fig. S6 (a) DS emission spectral changes of the NBEN:xYb ($x=0.12$) ceramic sample excited by

487nm for different in-situ irradiation cycles. (b) The ΔR_t values of the sample as a function of irradiation cycles (n).

Table S1 Fitting results of Raman spectra (a) before and (b) after 407 nm light irradiation (LD, 200 mW) for all samples.

Modes (cm^{-1})	Samples before irradiation							
	0	0.01	0.03	0.05	0.07	0.09	0.12	0.15
ν_1	67.21	66.05	65.85	66.60	67.60	67.48	68.53	67.07
ν_2	81.05	80.11	80.14	80.71	81.67	81.67	82.08	81.02
ν_3	107.51	104.90	106.59	107.14	108.33	108.13	107.05	106.87
ν_4	148.89	147.46	148.77	148.52	148.89	148.62	147.94	147.35
ν_5	185.00	184.20	185.11	184.72	185.05	185.03	183.78	184.24
ν_6	218.01	216.61	218.06	217.97	218.37	219.34	216.78	217.39
ν_7	262.65	260.86	264.47	263.80	264.00	266.75	262.59	262.69
ν_8	332.87	330.05	330.87	329.02	329.83	325.97	329.44	327.85
ν_9	419.68	425.40	418.47	422.05	420.80	426.86	425.25	422.23
ν_{10}	570.30	570.87	574.13	572.78	572.32	576.93	570.53	569.97

Table S2 The band gap energies (E_g and E_g^*) of NBN:xHo samples before and after 407 nm light irradiation (LD, 200 mW).

Samples	x=0	x=0.01	x=0.03	x=0.05	x=0.07	x=0.09	x=0.12	x=0.15
E_g (eV)	3.11	2.95	2.87	2.84	3.00	2.87	3.15	2.65
E_g^* (eV)	3.18	3.04	3.00	2.94	3.10	2.94	3.22	2.81

E_g^* means the gap after irradiation