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Supplementary Information

Reversible colorless-cyan photochromism in Eu^{2+}-doped $Sr_3YNa(PO_4)_3F$ powders

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Table S1. Refined structure parameters of SYNPF derived from the Rietveld refinement of X-ray diffraction data.

Atom	Wyckoff position	x	y	z	Frac
Y	2d	0.3333	0.6667	0.5007	1.0000
Na	2d	0.3333	0.6667	0.0119	1.0000
Sr	6g	0.2415	0.2552	0.2526	1.0000
P	6g	0.3665	0.3995	0.7423	1.0000
O1	6g	0.4817	0.3329	0.7957	1.0000
O2	6g	0.4392	0.5677	0.7792	1.0000
O3	6g	0.2587	0.3365	0.9190	1.0000
O4	6g	0.2508	0.3349	0.5806	1.0000
F	2c	0.0000	0.0000	0.2202	1.0000
Cell parameters: a=b=9.627241 Å, c=7.133053 Å, V=572.545 Å^3, Z=2; space group: *P*-3(no.147); Reliability factors: R_{wp}=3.97%, Rp =2.74% and χ^2=2.98					

Table S2. Chemical composition of the SYNPF:0.005Eu^{2+} sample by XRF analysis.

Chemical composition	Sr	Y	P	Na	Eu	F
Mass(wt%)	53.6082	17.1567	18.7629	4.3299	0.1651	4.1237
Molar ratio	n(Sr):n(Y):n(P):n(Na):n(Eu):n(F)=3.2485:1.0246:3.2167:1.000:0.0058:1.1521					

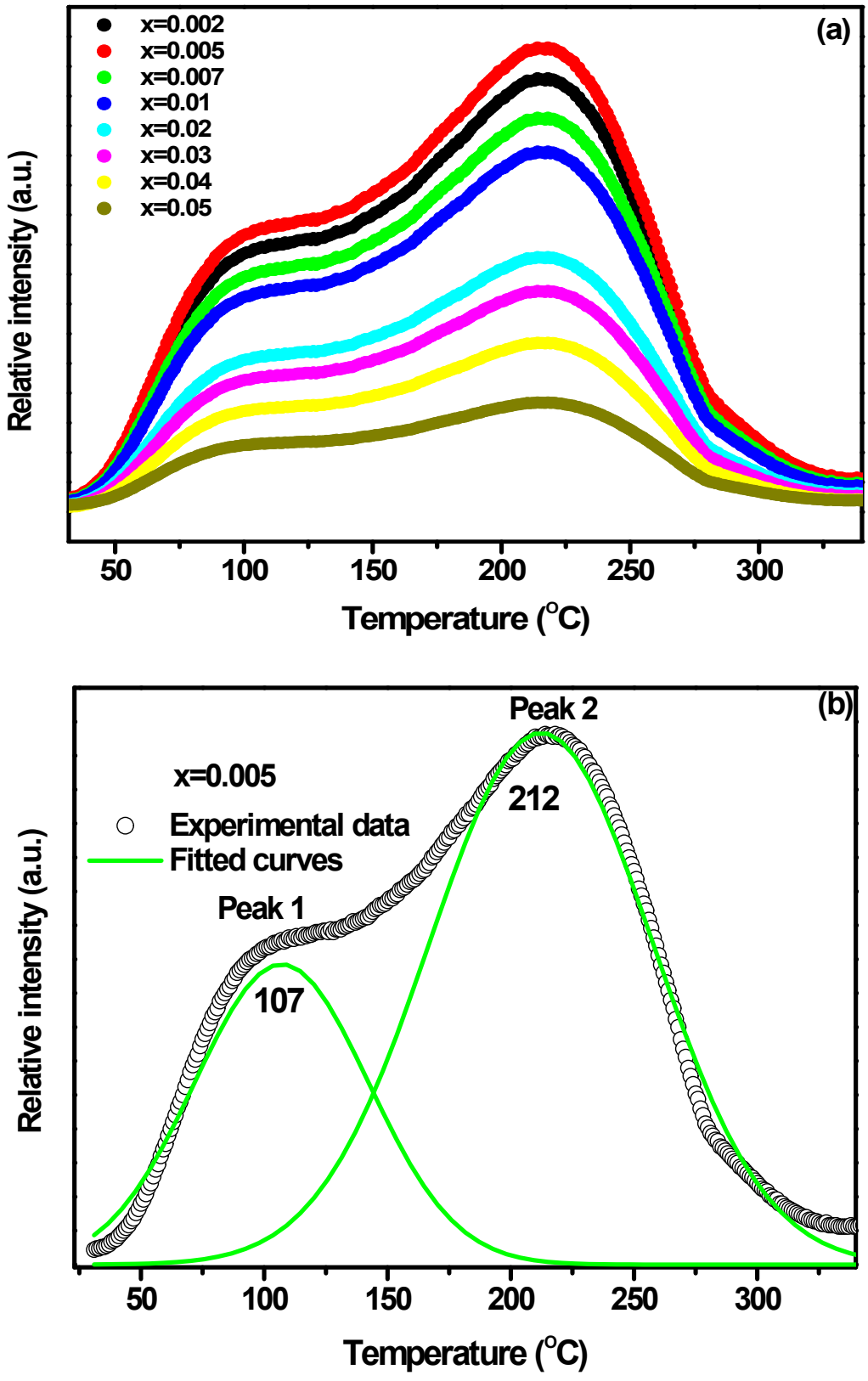

Fig. S1 (a) TL glow curves of SYNPF:xEu^{2+} (x=0.002-0.05) after irradiated by 254 nm

for 5 min with delay 5 min time; (b) Experimental data of SYNPF:0.005Eu^{2+} (black dots) and deconvoluted two peaks (green curves) based on Gaussian function.

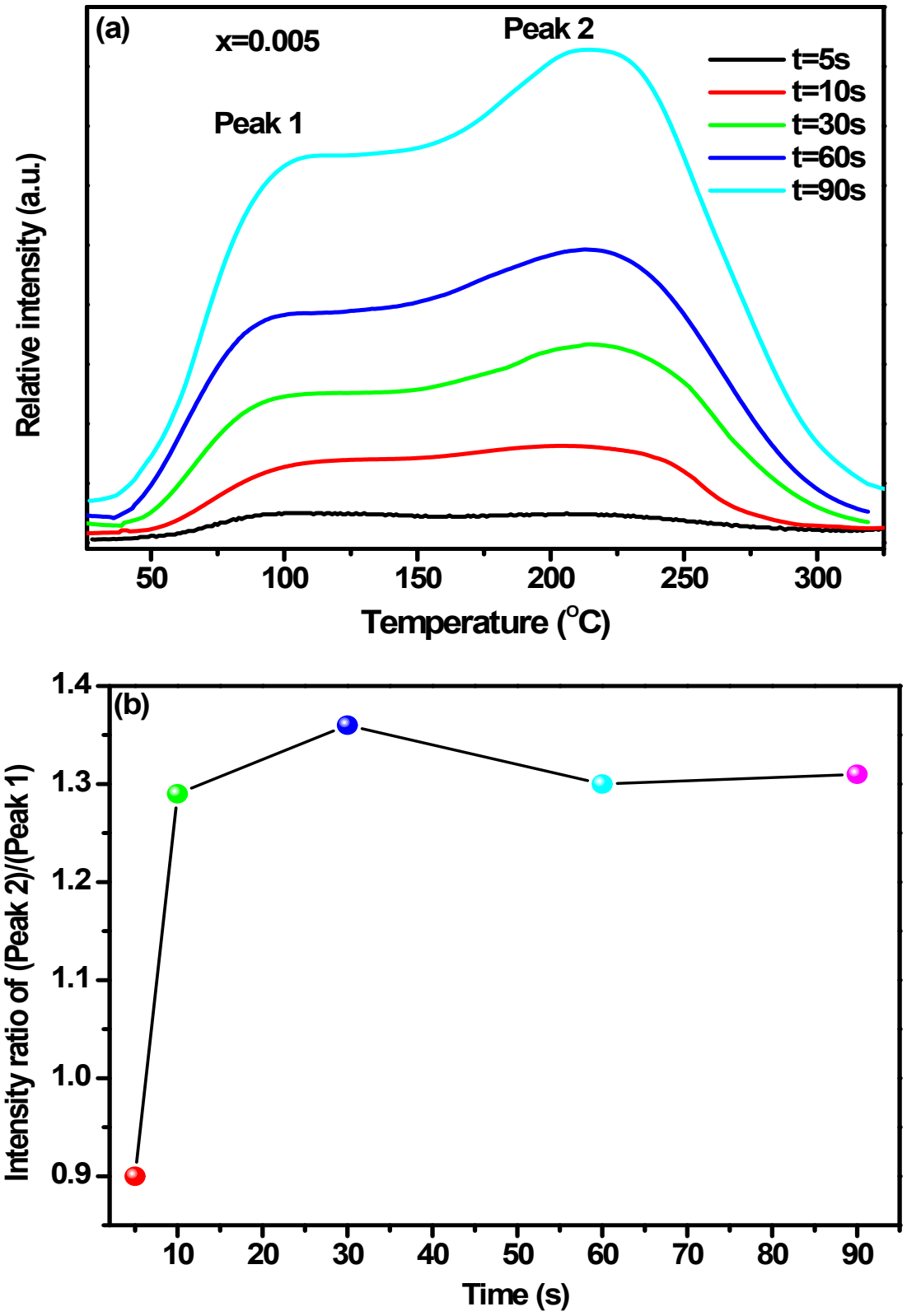

Fig. S2 (a) TL glow curves of SYNPF:0.005Eu^{2+} after irradiated by 254 nm for different dwell times (t=5-90 s); (b) Intensity ration of [(Peak 2)/(Peak 1)] as a function of irradiation

(254 nm) time.

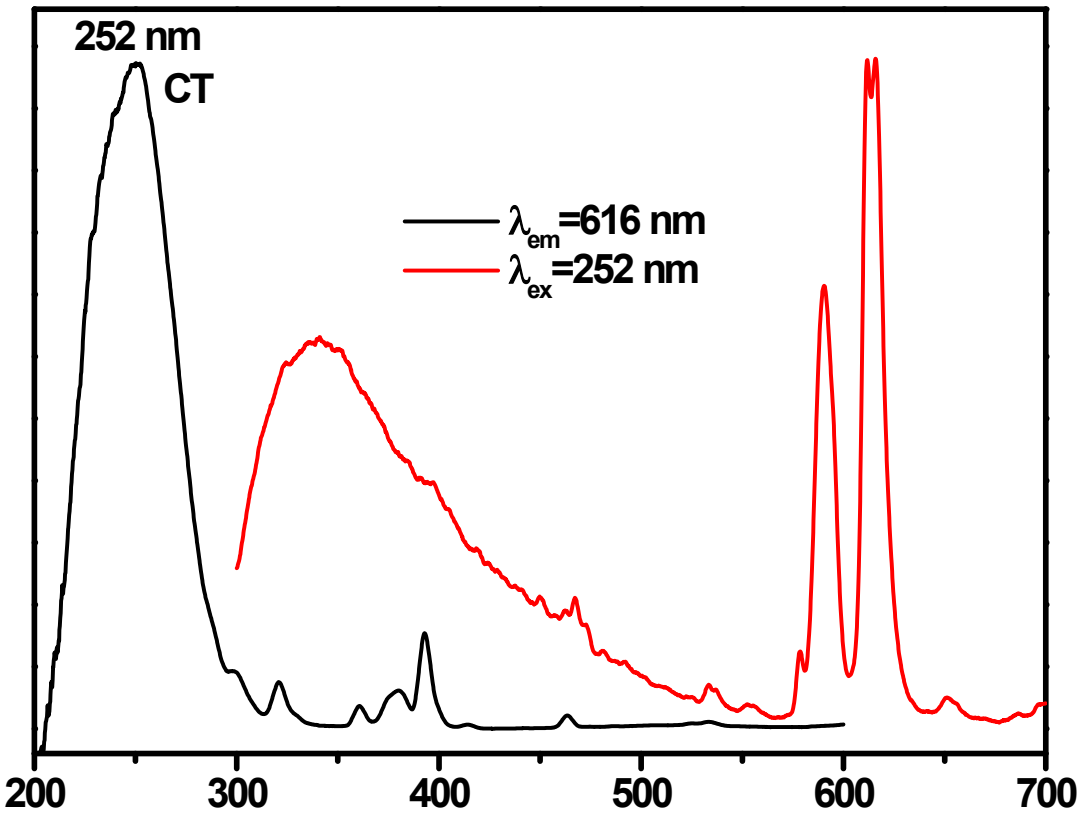

Fig. S3 Excitation (λ_{em}=616 nm) and emission (λ_{ex}=252 nm) spectra of SYNPF:Eu^{3+};

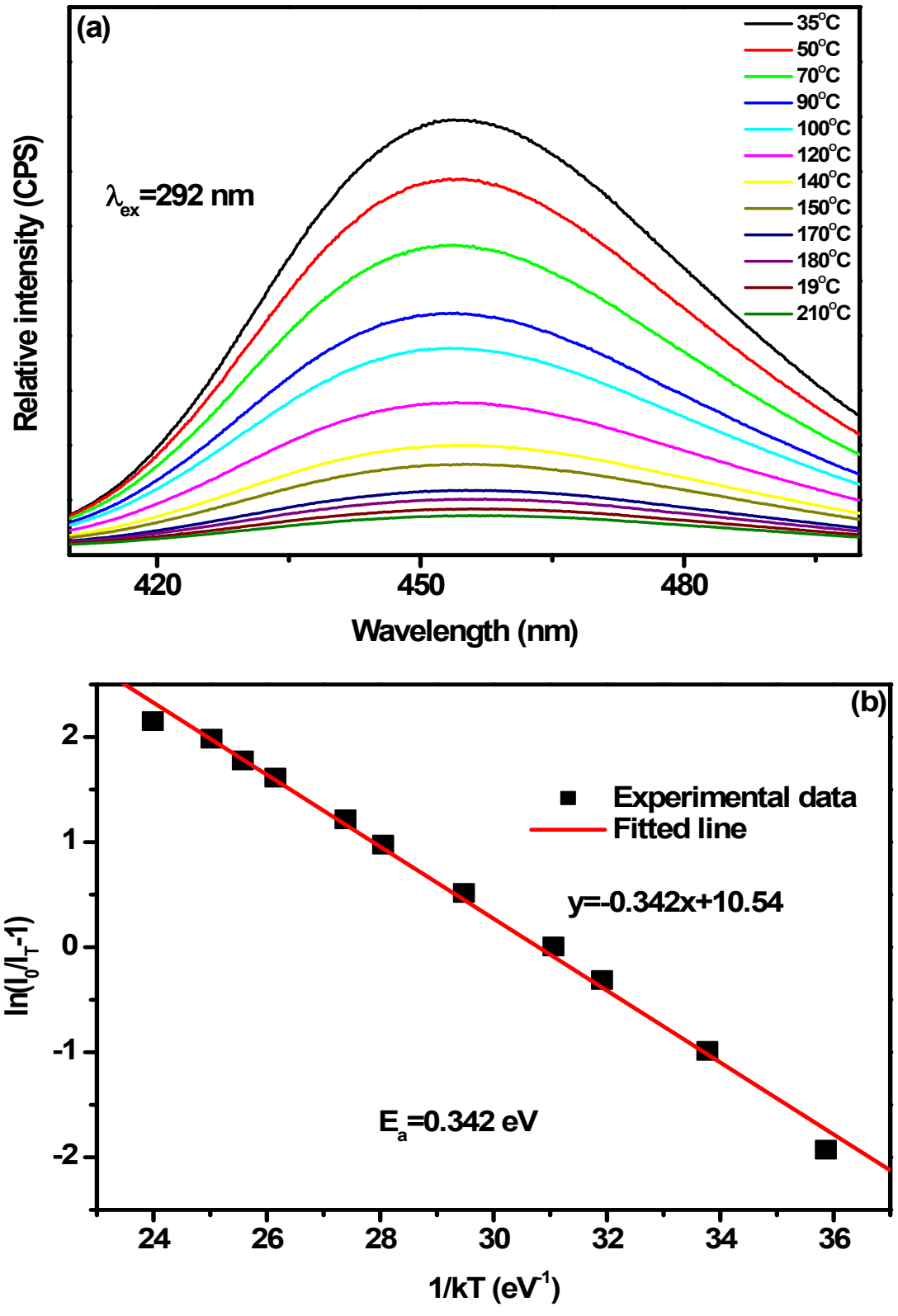

Fig. S4 (a) Temperature dependent emission spectra of SYNPF:0.005Eu^{2+} (λ_{ex}=292 nm); (b) The dependence of $In[(I_0/I_T)-1]$ on $1/kT$, (black dots are experimental data and red line is linear fitted result).

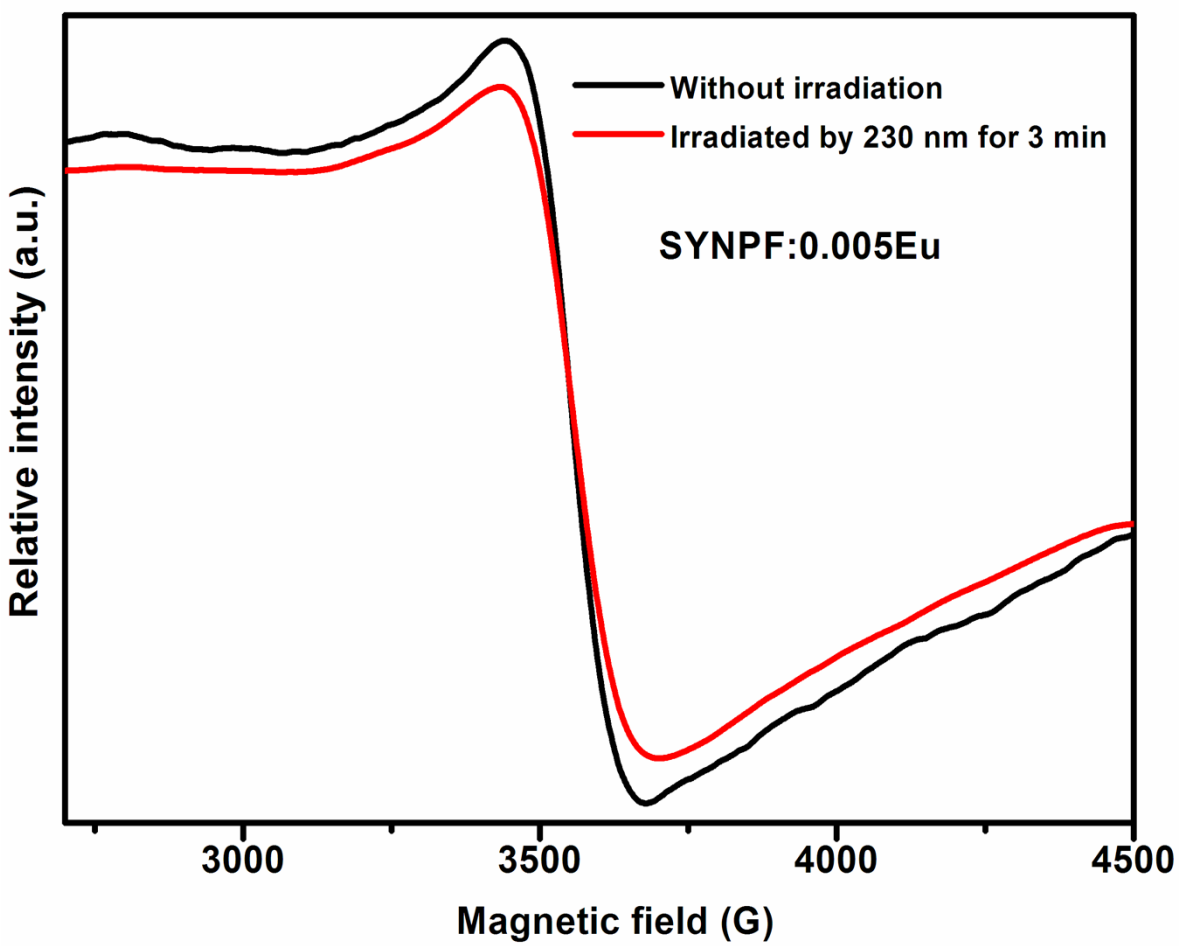

Fig. S5 EPR spectra of SYNPF:0.005Eu2+ with and without irradiation by 230 nm for 3 min at room temperature (25 °C) in air atmosphere.