Facile synthesis of Er^{3+}/Yb^{3+}-codoped NaYF$_4$ nanoparticles: A promising multifunctional upconverting luminescent material for versatile applications

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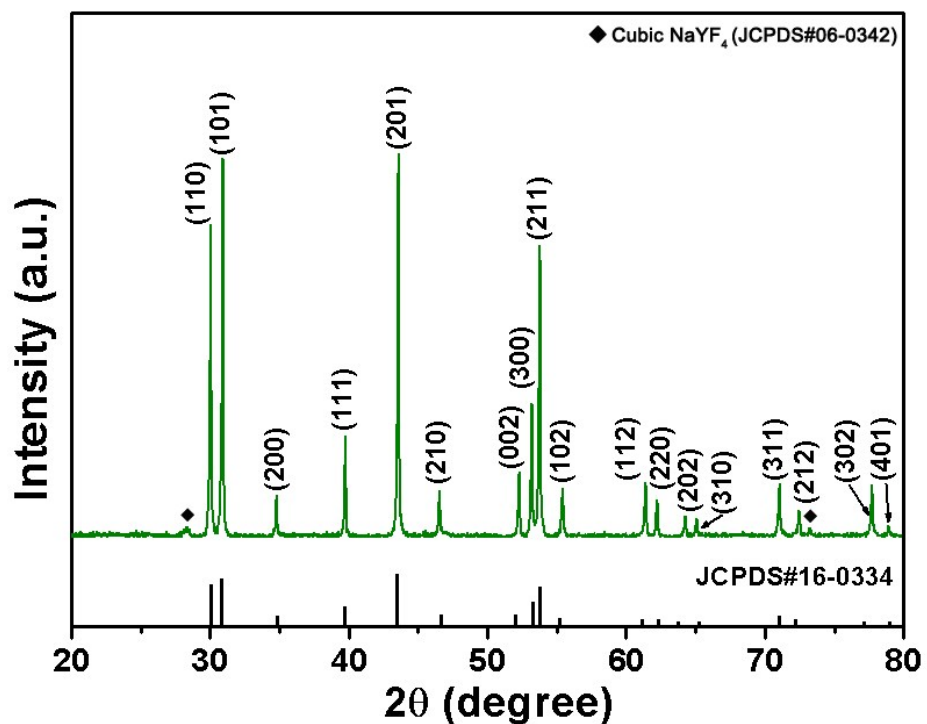
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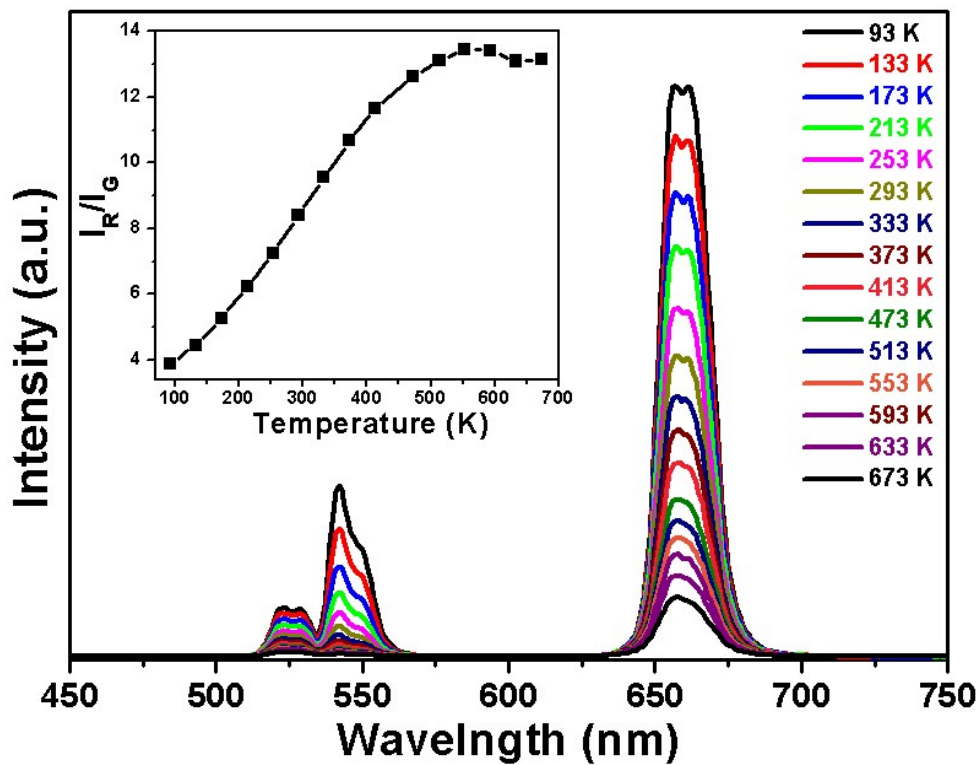
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Figure S1 XRD pattern of the NaYF$_4$:Er^{3+}/Yb^{3+} nanoparticles. The diffraction peaks of the cubic phase were marketed as ◆.

Table S1. Refined structural parameters for the $NaYF_4:Er^{3+}/Yb^{3+}$ nanoparticles.

Sample	$NaYF_4:Er^{3+}/Yb^{3+}$
Phase structure	Hexagonal
Space group	P63/m(176)
$a = b$	5.932823 (Å)
c	3.482378 (Å)
$\alpha = \beta$	90°
γ	120°
V	106.152 (Å^3)
R_p	9.38%
R_{wp}	12.58%
χ^2	0.891

Figure S2. UC emission spectra of the $NaYF_4:Er^{3+}/Yb^{3+}$ nanoparticles excited at 980 nm of light in the temperature range of 93-673 K. Inset shows the dependence of I_R/I_G ratio on temperature.

Table S2. CIE chromaticity coordinates of the $NaYF_4:Er^{3+}/Yb^{3+}$ nanoparticles at different temperatures.

Temperature (K)	CIE color coordinates		Excitation wavelength (nm)
	x	y	
93	0.446	0.543	980
133	0.462	0.527	980
173	0.481	0.508	980
213	0.501	0.488	980
253	0.520	0.469	980
293	0.537	0.452	980
333	0.552	0.437	980
373	0.565	0.425	980
413	0.575	0.415	980
473	0.584	0.406	980
513	0.588	0.401	980
553	0.590	0.399	980
593	0.591	0.398	980
633	0.588	0.400	980
673	0.588	0.399	980

Table S3. Calculated temperature and the corresponding FIR values for the $NaYF_4$:Er^{3+}/Yb^{3+} nanoparticles at different pump powers.

Pump power (mW)	FIR value	Temperature (K)	Excitation wavelength (nm)
84	0.534	255.03	980
172	0.608	283.82	980
260	0.705	318.74	980
377	0.781	345.06	980
585	0.860	372.03	980