

## Supporting information

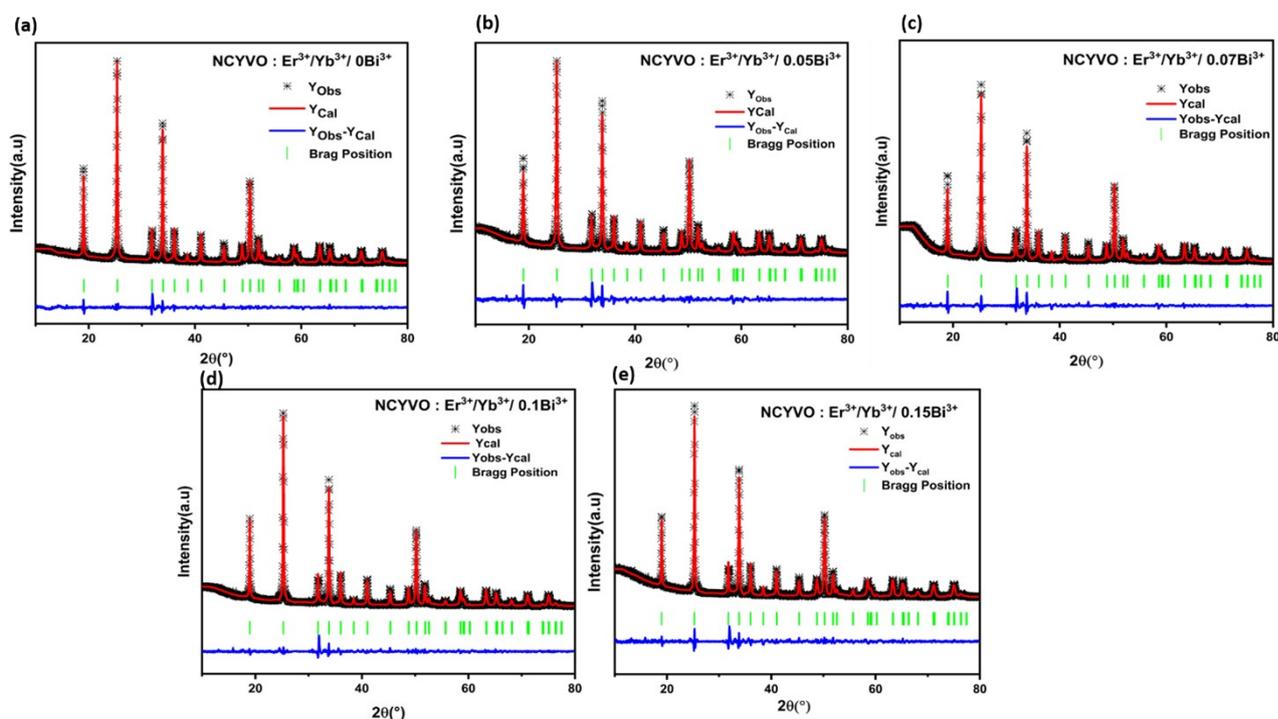
### Bi<sup>3+</sup>-Sensitized Up-Conversion Luminescence and Non-Contact Optical Thermometry in NaCaYV<sub>2</sub>O<sub>8</sub>: Er<sup>3+</sup>/Yb<sup>3+</sup> Phosphors

Fadwa Ayachi <sup>a</sup>, Kamel Saidi <sup>a,b</sup>, I. Mediavilla-Martínez <sup>c</sup>, Mohamed Dammak <sup>\*a</sup>, J. Jimenez <sup>c</sup>

<sup>a</sup> Laboratoire de Physique Appliquée, Faculté des Sciences de Sfax, Département de Physique, Université de Sfax, BP 1171, Sfax, Tunisia.

<sup>b</sup> Department of Physics, Sfax Preparatory Engineering Institute, University of Sfax, 1172 - 3000, Sfax, Tunisia.

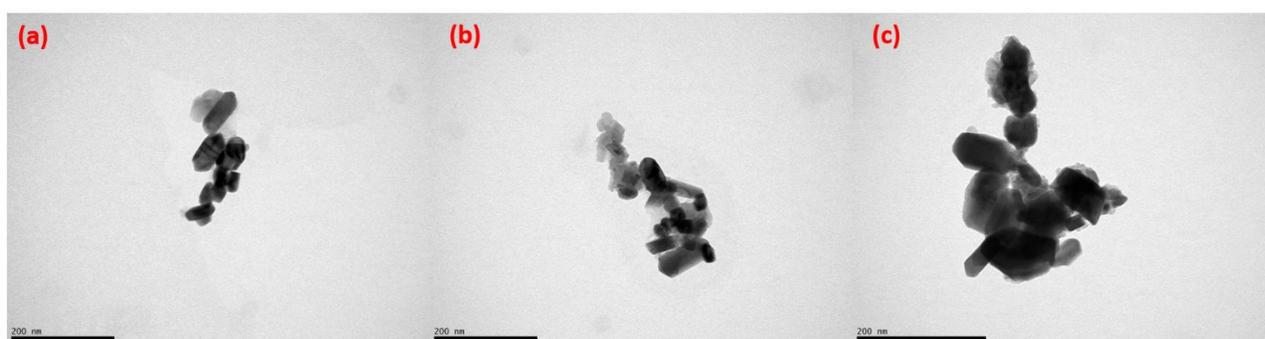
<sup>c</sup> GdS Optronlab, Department of Condensed Matter Physics, LUCIA Building University of Valladolid, Paseo de Belen 19, 47011, Valladolid, Spain.



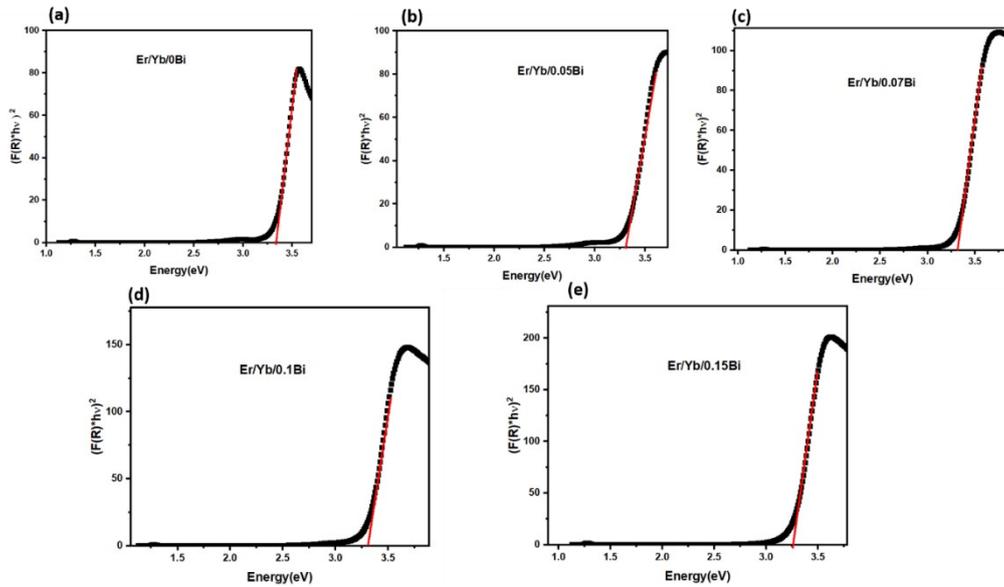
**Figure S1:** Rietveld refinement plots of the NaCaYV<sub>2</sub>O<sub>8</sub>:0.02Er<sup>3+</sup>/0.10Yb<sup>3+</sup> phosphors with varying Bi<sup>3+</sup> doping concentrations: **(a)** 0 mol% (Bi-free), **(b)** 5 mol%, **(c)** 7 mol%, **(d)** 10 mol%, and **(e)** 15 mol%. The observed (black dots), calculated (red line), and difference (blue line) profiles are shown, along with Bragg reflection positions (vertical bars).

**Table S1:** Rietveld refinement parameters from XRD analysis

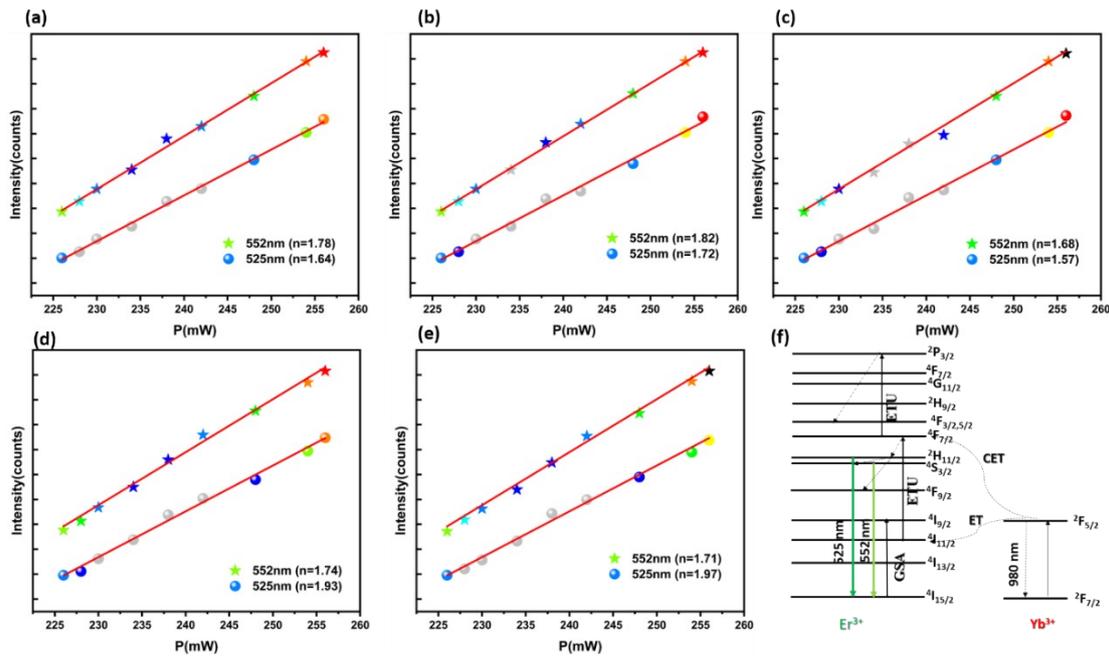
Sample	$a(\text{\AA})$	$b(\text{\AA})$	$c(\text{\AA})$	$V(\text{\AA}^3)$	$R_{wp}(\%)$	$\chi^2$	$\epsilon(10^{-3})$	$D_{w-H}(\text{nm})$
<b>NCYVO:</b> <b>Er<sup>3+</sup>/Yb<sup>3+</sup>/0Bi<sup>3+</sup></b>	7.02810	7.02810	6.23649	308.047	16.2	1.84	6.3	22
<b>NCYVO:</b> <b>Er<sup>3+</sup>/Yb<sup>3+</sup>/0.05</b> <b>Bi<sup>3+</sup></b>	7.05259	7.05259	6.25639	311.187	16.8	1.64	4.2	33
<b>NCYVO:</b> <b>Er<sup>3+</sup>/Yb<sup>3+</sup>/0.07Bi<sup>3+</sup></b>	7.04914	7.04914	6.25386	310.757	16	1.75	1.3	60
<b>NCYVO:</b> <b>Er<sup>3+</sup>/Yb<sup>3+</sup>/0.1 Bi<sup>3+</sup></b>	7.05473	7.05473	6.25994	311.552	15.9	1.61	3.2	43
<b>NCYVO:</b> <b>Er<sup>3+</sup>/Yb<sup>3+</sup>/0.15</b> <b>Bi<sup>3+</sup></b>	7.05982	7.05982	6.26354	312.182	16.9	1.54	3.9	35



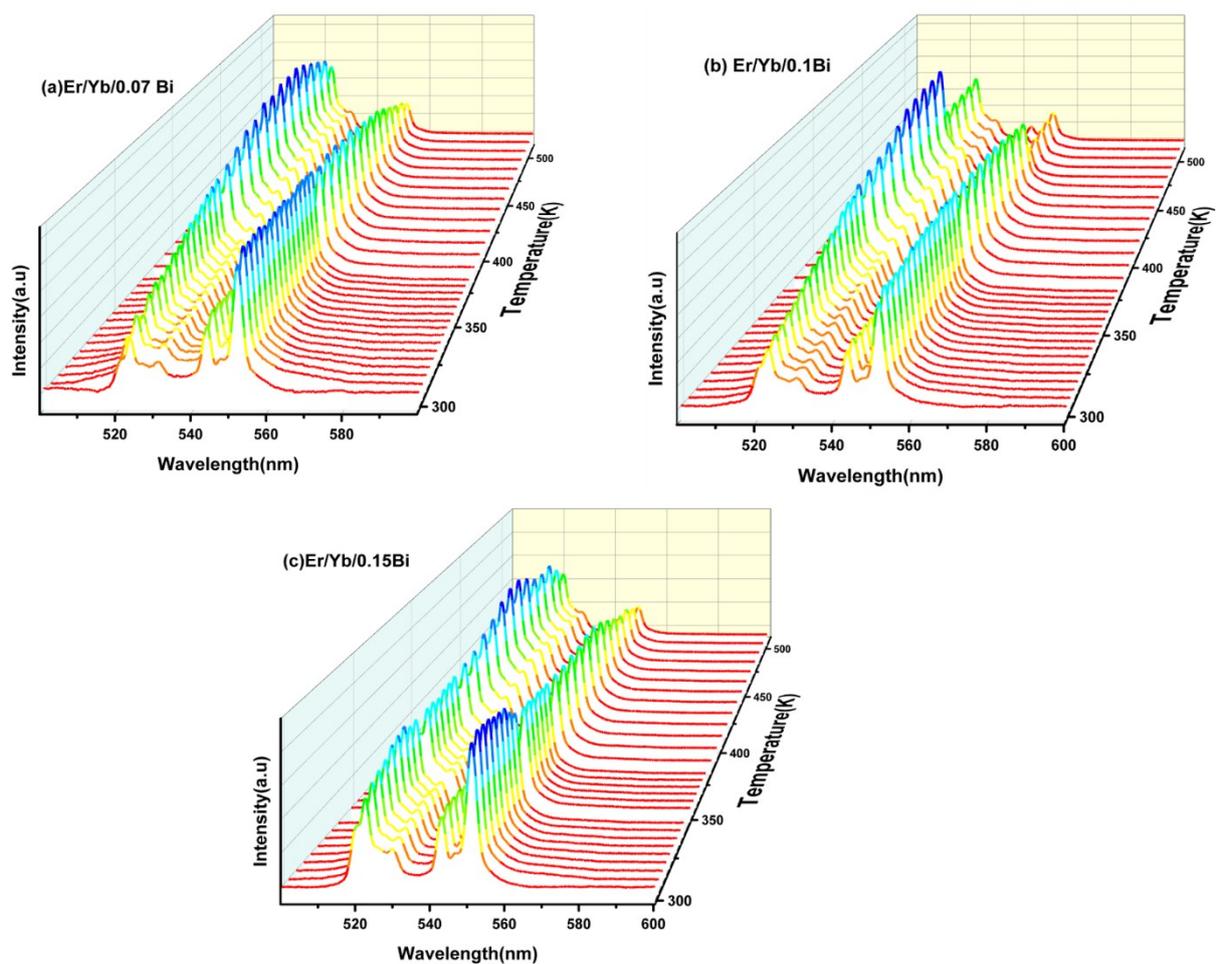
**Figure S2 :**Transmission electron microscopy (TEM) images illustrating the surface morphology of  $\text{NaCaYV}_2\text{O}_8:0.02\text{Er}^{3+}/0.10\text{Yb}^{3+}$  phosphors with different  $\text{Bi}^{3+}$  concentrations: (c)5 mol%, (d)10 mol%, and (e)15 mol%.



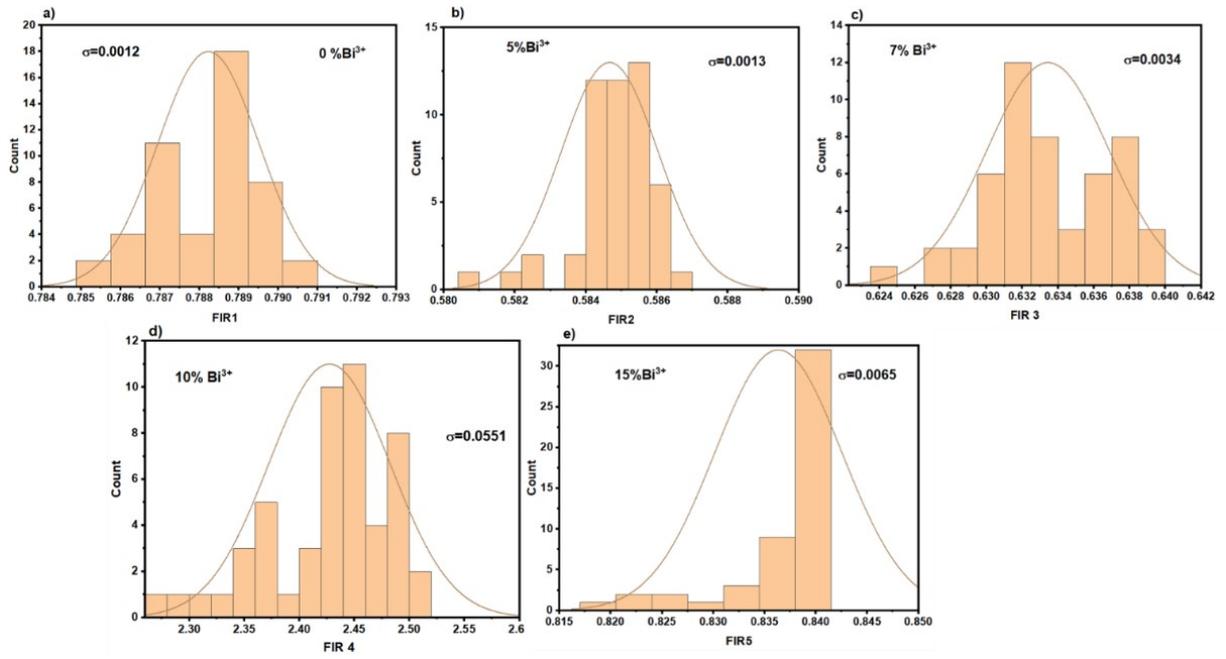
**Figure S3(a-e):** Tauc plots used for the determination of the optical band gap energy ( $E_g$ ) for the NaCaYV<sub>2</sub>O<sub>8</sub>:0.02Er<sup>3+</sup>/0.10Yb<sup>3+</sup> phosphors with Bi<sup>3+</sup> ( $x = 0-0.15$  mol).



**Figure S3 :** (a-e) Intensity plots of the up-conversion emission intensity versus pump power for the 525 nm and 552 nm transitions in NCYVO:0.02Er<sup>3+</sup>/0.10Yb<sup>3+</sup>/x%Bi<sup>3+</sup> phosphors ( $x = 0, 5, 7, 10, 15$ ), used to determine the number of photons  $n$  involved in the up-conversion process. (f) Schematic energy level diagram illustrating the proposed-up conversion mechanisms, including Ground State Absorption (GSA), Energy Transfer up conversion (ETU), and Cooperative Energy Transfer (CET) processes between Yb<sup>3+</sup>, Er<sup>3+</sup>, and Bi<sup>3+</sup> ions in the NCYVO host under 980 nm excitation.



**Figure S4.** Temperature-dependent up conversion (UC) emission spectra of (a) NCYVO: Er<sup>3+</sup>/Yb<sup>3+</sup>/0.07Bi<sup>3+</sup>, (b) NCYVO: Er<sup>3+</sup>/Yb<sup>3+</sup>/0.10 Bi<sup>3+</sup>, and (c) NCYVO: Er<sup>3+</sup>/Yb<sup>3+</sup>/0.15 Bi<sup>3+</sup> under 980 nm excitation.



**Figure S5:** Standard deviations at RT for **(a)** NCYVO : Er<sup>3+</sup>/Yb<sup>3+</sup>/0% Bi<sup>3+</sup>, **(b)** NCYVO : Er<sup>3+</sup>/Yb<sup>3+</sup>/5% Bi<sup>3+</sup>, **(c)** NCYVO:Er<sup>3+</sup>/Yb<sup>3+</sup>/7% Bi<sup>3+</sup>, **(d)**NCYVO : Er<sup>3+</sup>/Yb<sup>3+</sup>/10%Bi<sup>3+</sup>, and **(e)** NCYVO : Er<sup>3+</sup>/Yb<sup>3+</sup>/15% Bi<sup>3+</sup> under 980 nm excitation.