Electronic Supplementary Material (ESI) for Physical Chemistry Chemical Physics.


# Electronic Supplementary Information

## Intense NIR emissions at 0.8 µm, 1.47 µm, and 1.53 µm from colloidal $LiYbF_4:Ln^{3+}$ (Ln=$Tm^{3+}$ and $Er^{3+}$) nanocrystals

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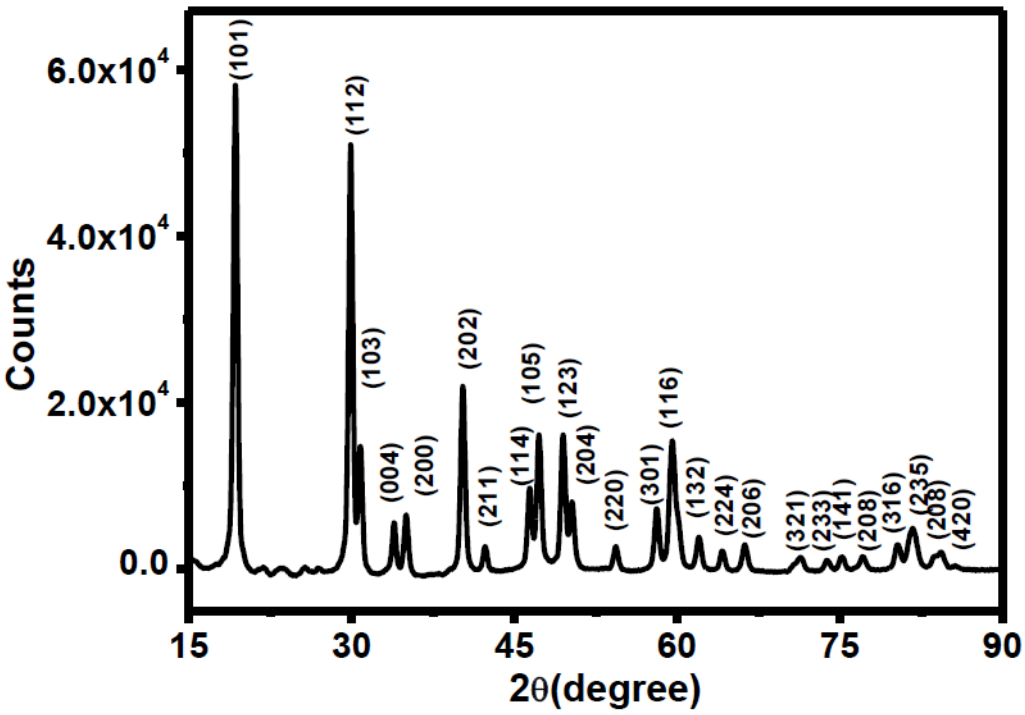


**Fig. S1.** Powder XRD pattern of 2 mol(%) $Er^{3+}$-doped $LiYbF_4$ nanocrystals.

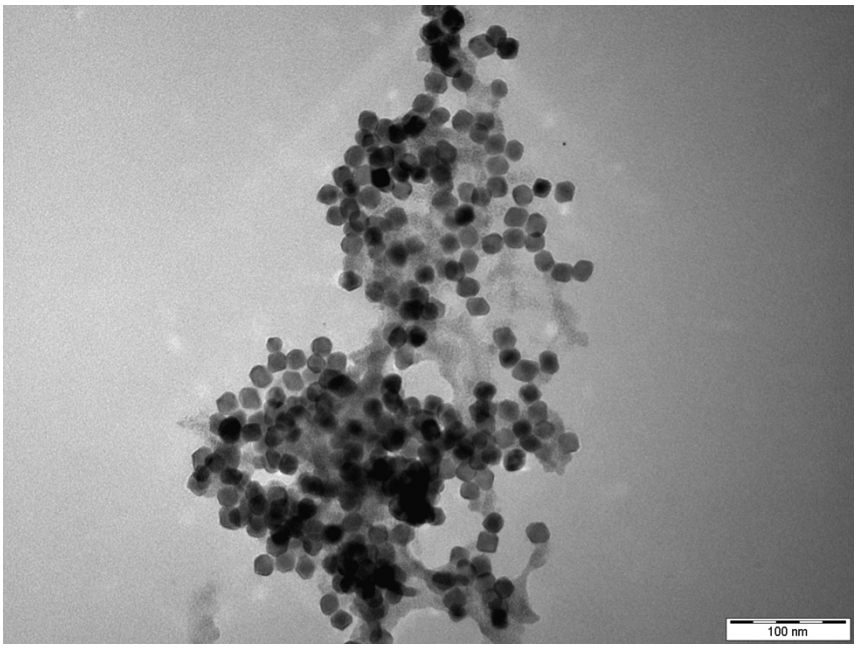


**Fig. S2.** The original TEM image of $Tm^{3+}$-doped $LiYbF_4$ nanocrystals

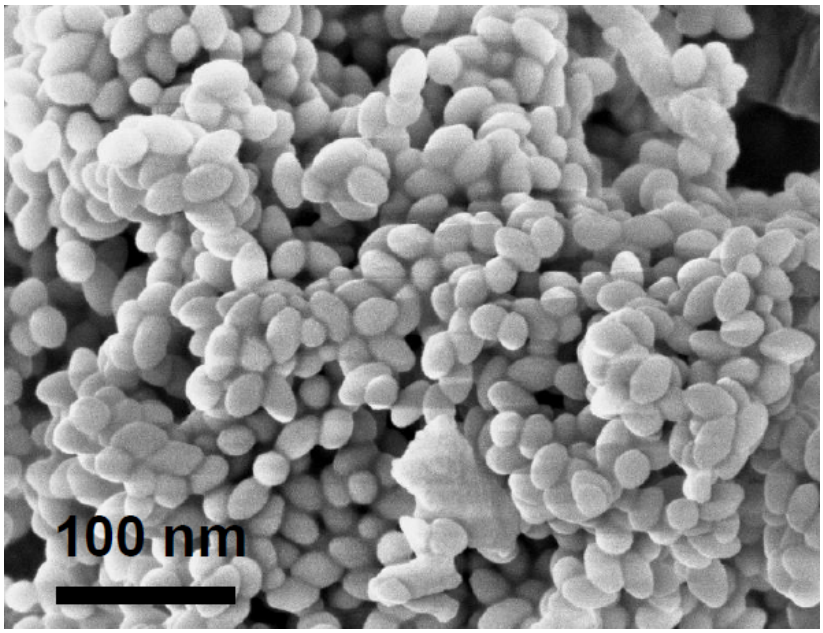


**Fig. S3.** Scanning electron microscopy (SEM) image of 1 mol(%) $Tm^{3+}$-doped $LiYbF_4$ nanocrystals.

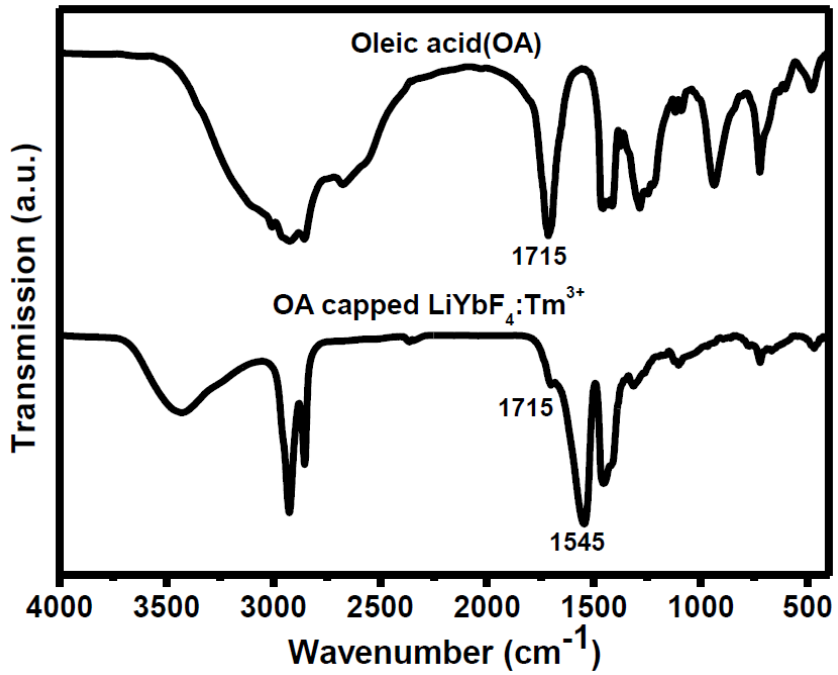


**Fig. S4.** FTIR spectra of oleic acid capped $Tm^{3+}$-doped $LiYbF_4$ nanocrystals along with pure oleic acid.

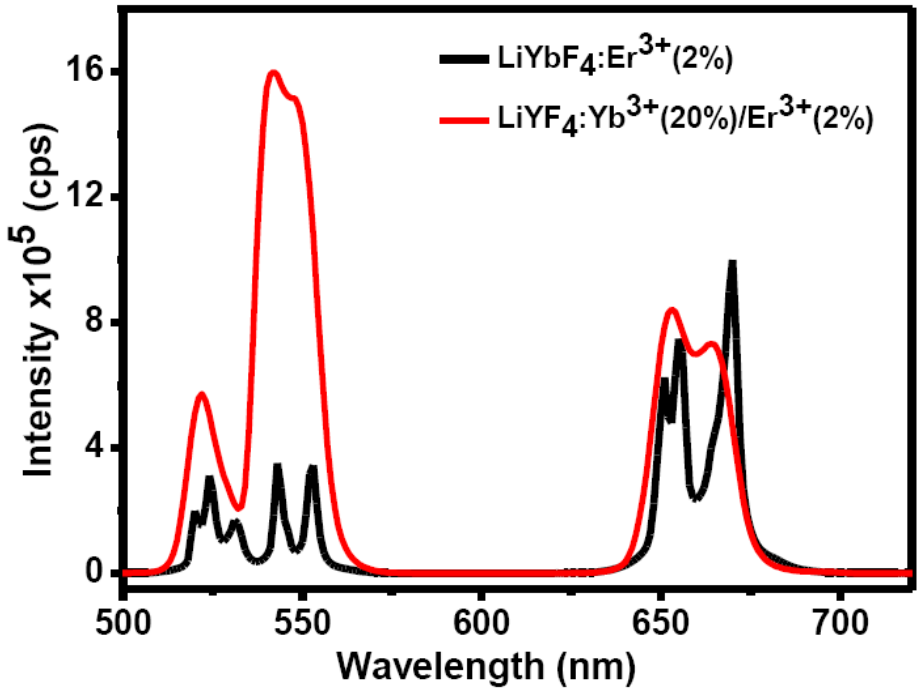


**Fig. S5.** A comparison of UC emission spectra of $LiYbF_4:Er^{3+}(2\%)$ (black trace) nanocrystals along with $LiYF_4:Yb^{3+}(20\%)/Er^{3+}(2\%)$ (red trace) upon 0.98 μm laser excitation.

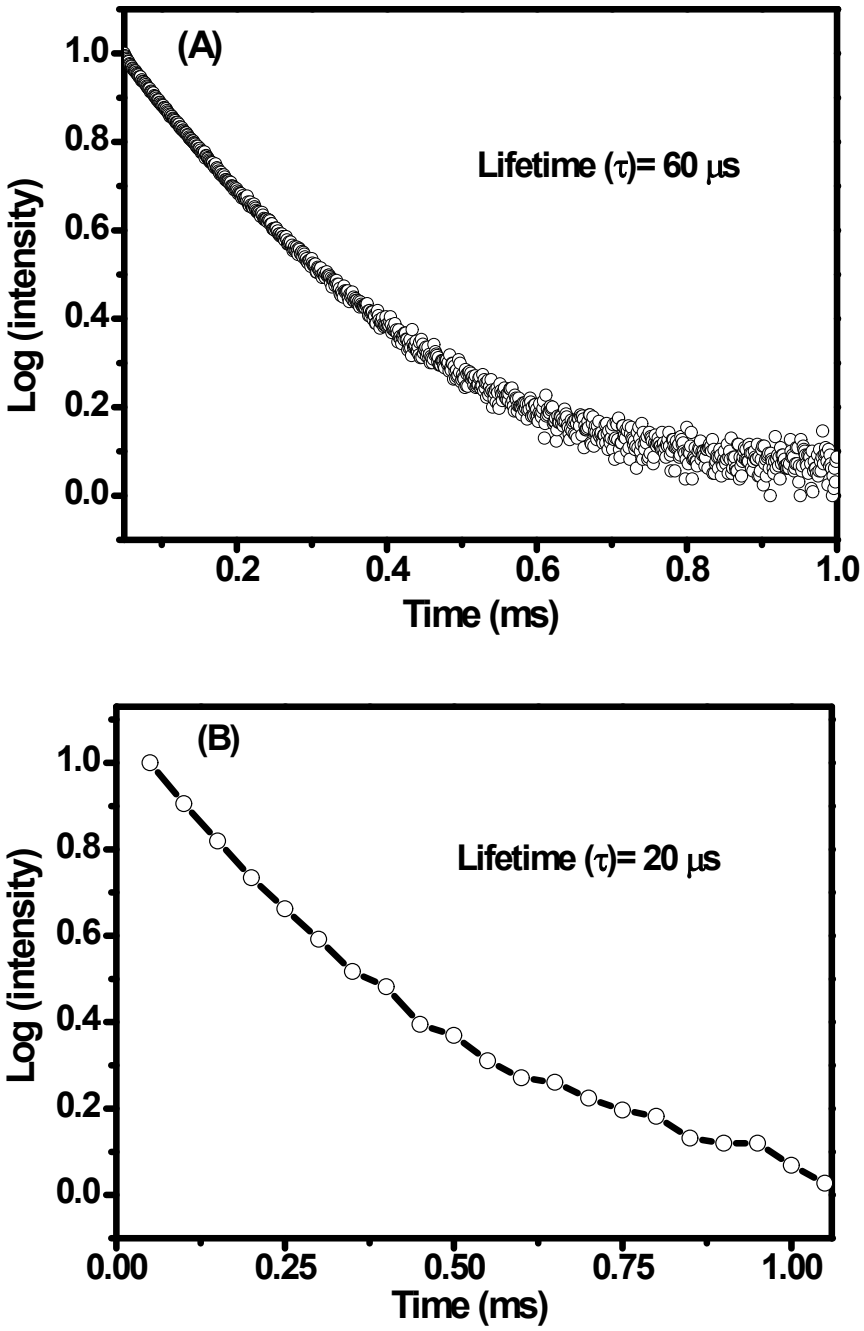


**Fig. S6.** Photoluminescence lifetime decay curves for (A) $Yb^{3+}$(20%)/$Er^{3+}$(2%)-doped $LiYF_4$ and (B) $Er^{3+}$(2%)-doped $LiYbF_4$ nanocrystals monitoring at $^4S_{13/2}\rightarrow{}^4I_{15/2}$ transitions under 0.488 μm direct excitation of $Er^{3+}$ ions.

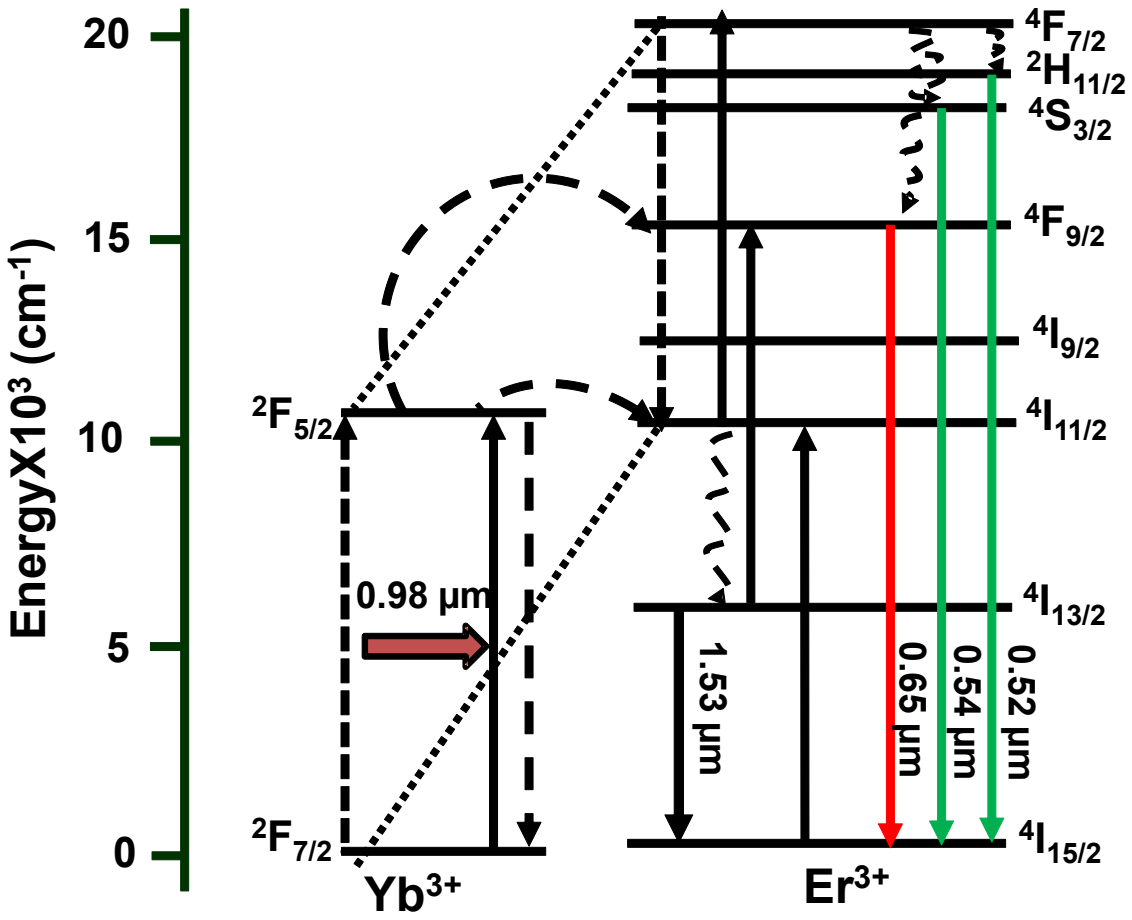


**Fig.S7.** Schematic energy level diagram with plausible transfer mechanism between $Yb^{3+}$ and $Er^{3+}$ ions in the upconversion processes. Corresponding cross relaxation (CR) is also shown.

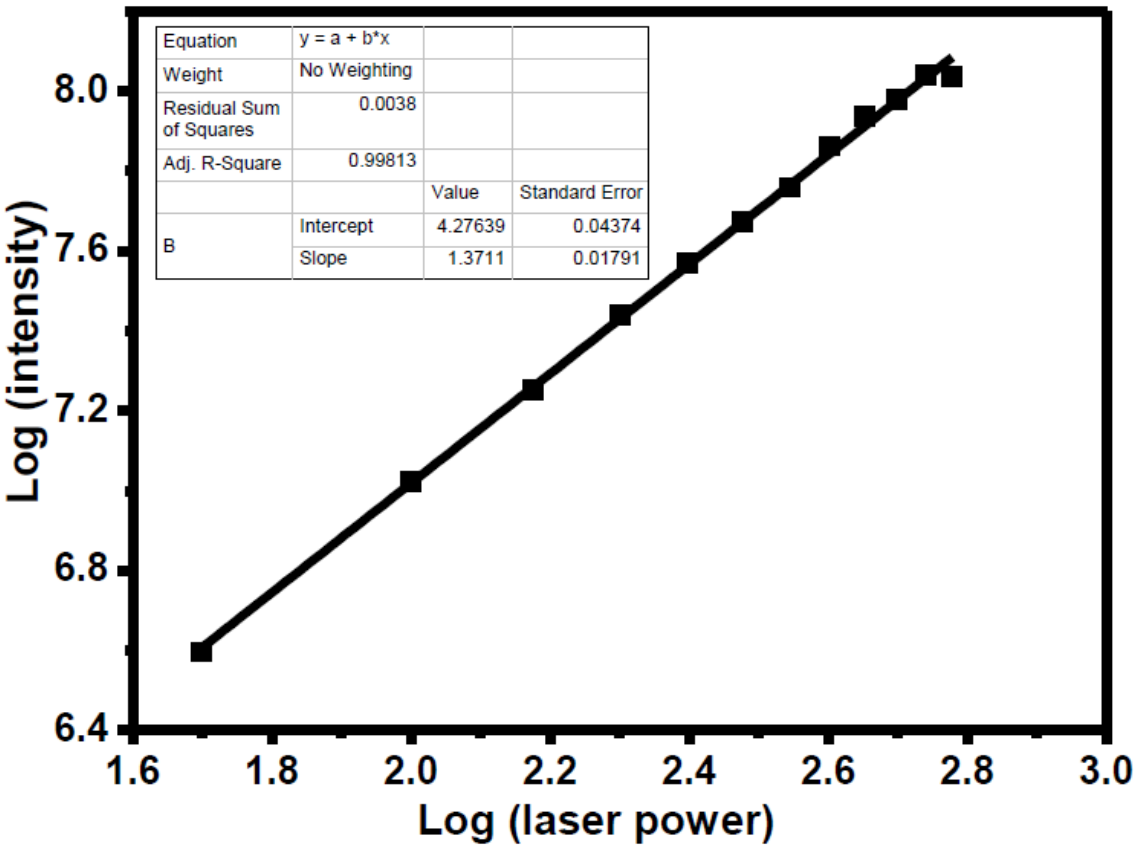


**Fig. S8.** Logarithmic plot of laser power verses upconversion emission intensity for the 1.47 μm emission peak from $Tm^{3+}$(1%)-doped $LiYbF_4$ nanocrystals monitoring.

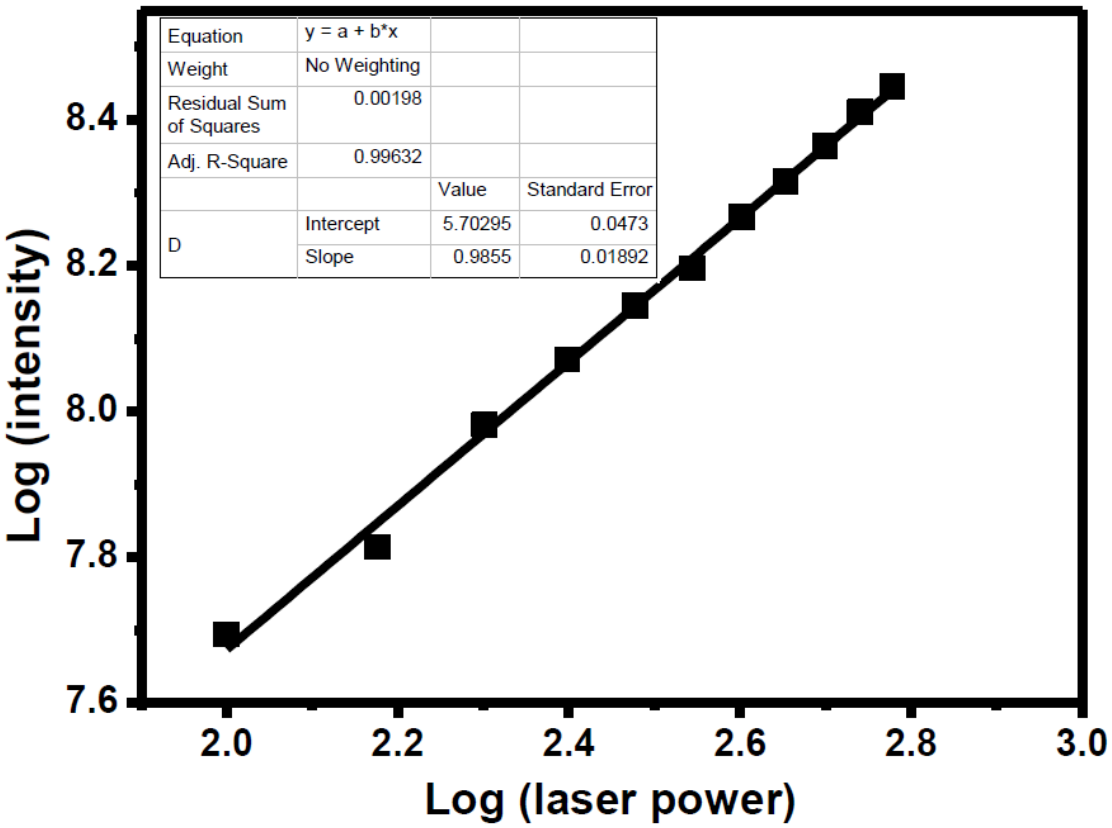


**Fig. S9.** Logarithmic plot of laser power verses upconversion emission intensity for the 1.53 μm emission peak from $Er^{3+}$(2%)-doped $LiYbF_4$ nanocrystals monitoring