

(Supplementary Information)

Hydrothermal Synthesis of Arginine Decorated $\text{Na}_x\text{Li}_y\text{Pr}(\text{MoO}_4)_2:\text{Tb}^{3+}$ and $\text{Na}_x\text{Li}_y\text{Pr}(\text{WO}_4)_2:\text{Tb}^{3+}$ Nanomaterials: Photocatalytic Degradation and Luminescent Sensing of Picric Acid in an Aqueous Medium

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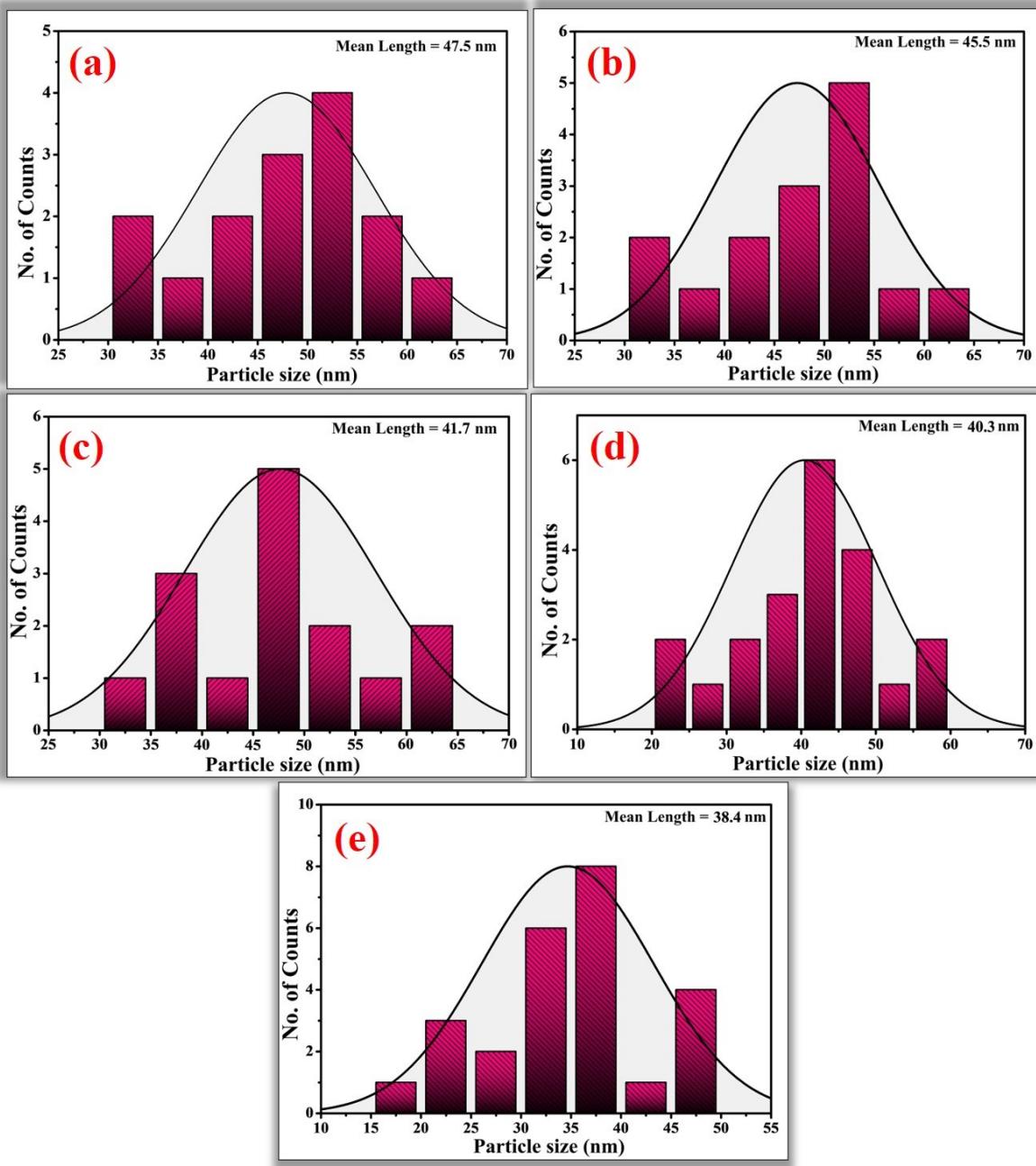


Fig. S1 SEM particle distribution graphs of as-synthesized $\text{Na}_x\text{Li}_y\text{Pr}(\text{WO}_4)_2:\text{Tb}^{3+}$ nanoparticles with different Li/Na ions concentrations: (Where $x/y =$ (a) $x=15$ mmol $y=0$ mmol, (b) $x=12.5$ mmol, $y=2.5$ mmol, (c) $x=10$ mmol $y= 5$ mmol, (d) $x=5$ mmol, $y=10$ mmol and (e) $x=0$ mmol, $y=15$ mmol)

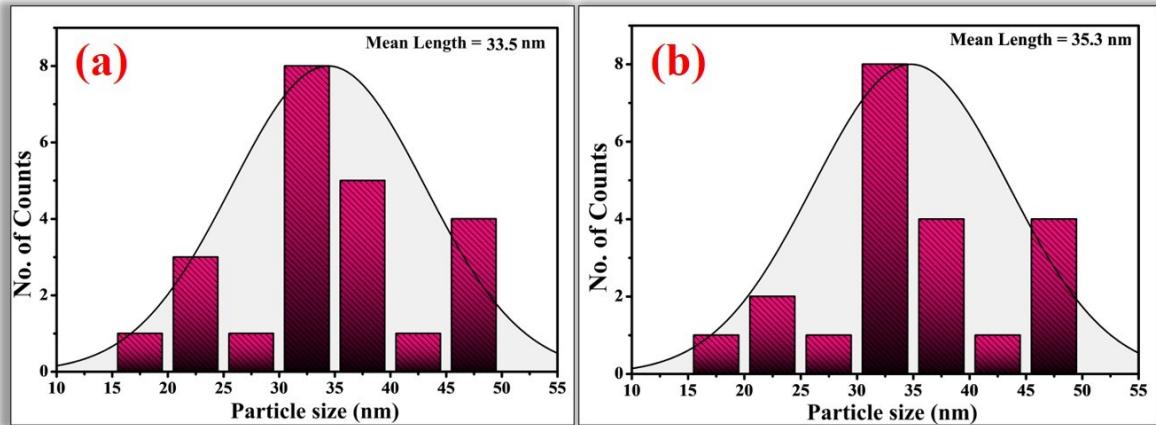


Fig. S2 Particle distribution graphs of (a) $\text{Na}_x\text{Li}_y\text{Pr}(\text{MoO}_4)_2:\text{Tb}^{3+}$ @Arg and (b) $\text{Na}_x\text{Li}_y\text{Pr}(\text{MoO}_4)_2:\text{Tb}^{3+}$ @Lys ($x=10$ mmol and $y=5$ mmol)

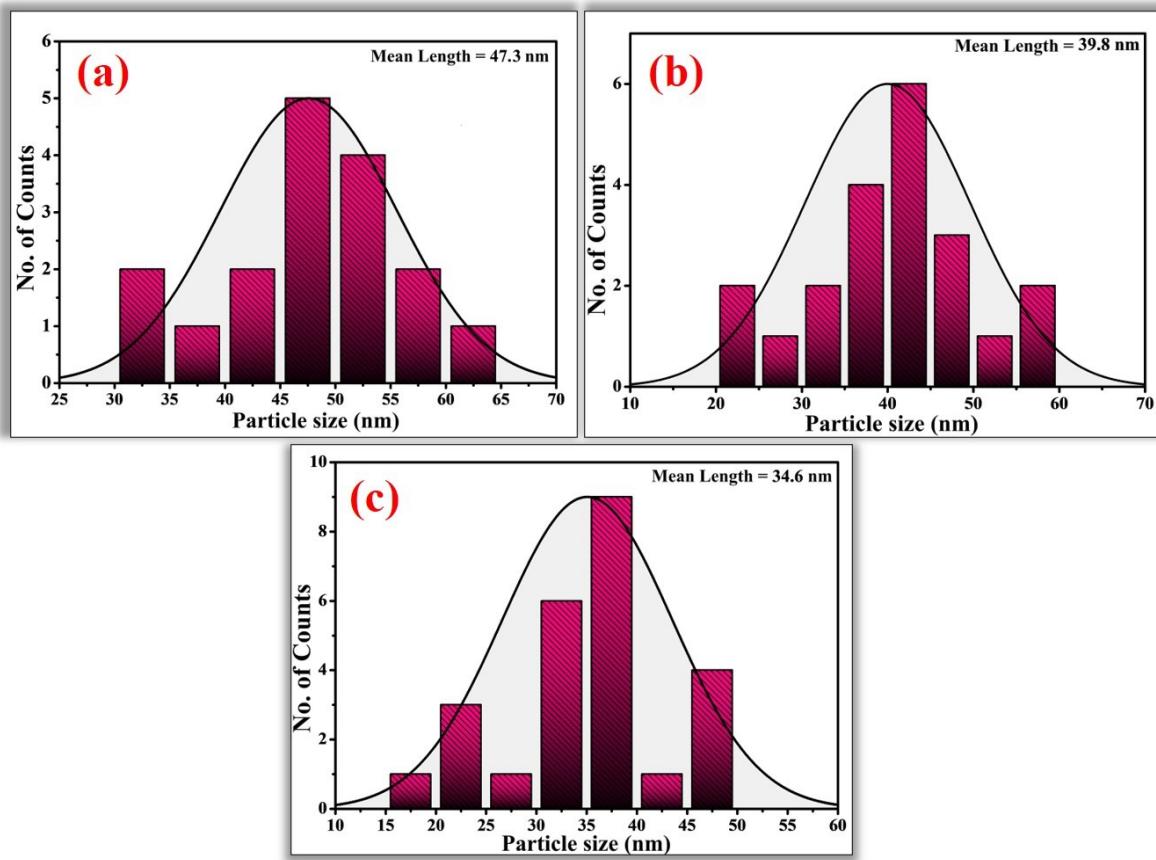


Fig. S3 Particle distribution graphs of (a) $\text{Na}_x\text{Li}_y\text{Pr}(\text{WO}_4)_2:\text{Tb}^{3+}$, (b) $\text{Na}_x\text{Li}_y\text{Pr}(\text{WO}_4)_2:\text{Tb}^{3+}$ @Lys and (c) $\text{Na}_x\text{Li}_y\text{Pr}(\text{WO}_4)_2:\text{Tb}^{3+}$ @Arg ($x=10$ mmol and $y=5$ mmol)

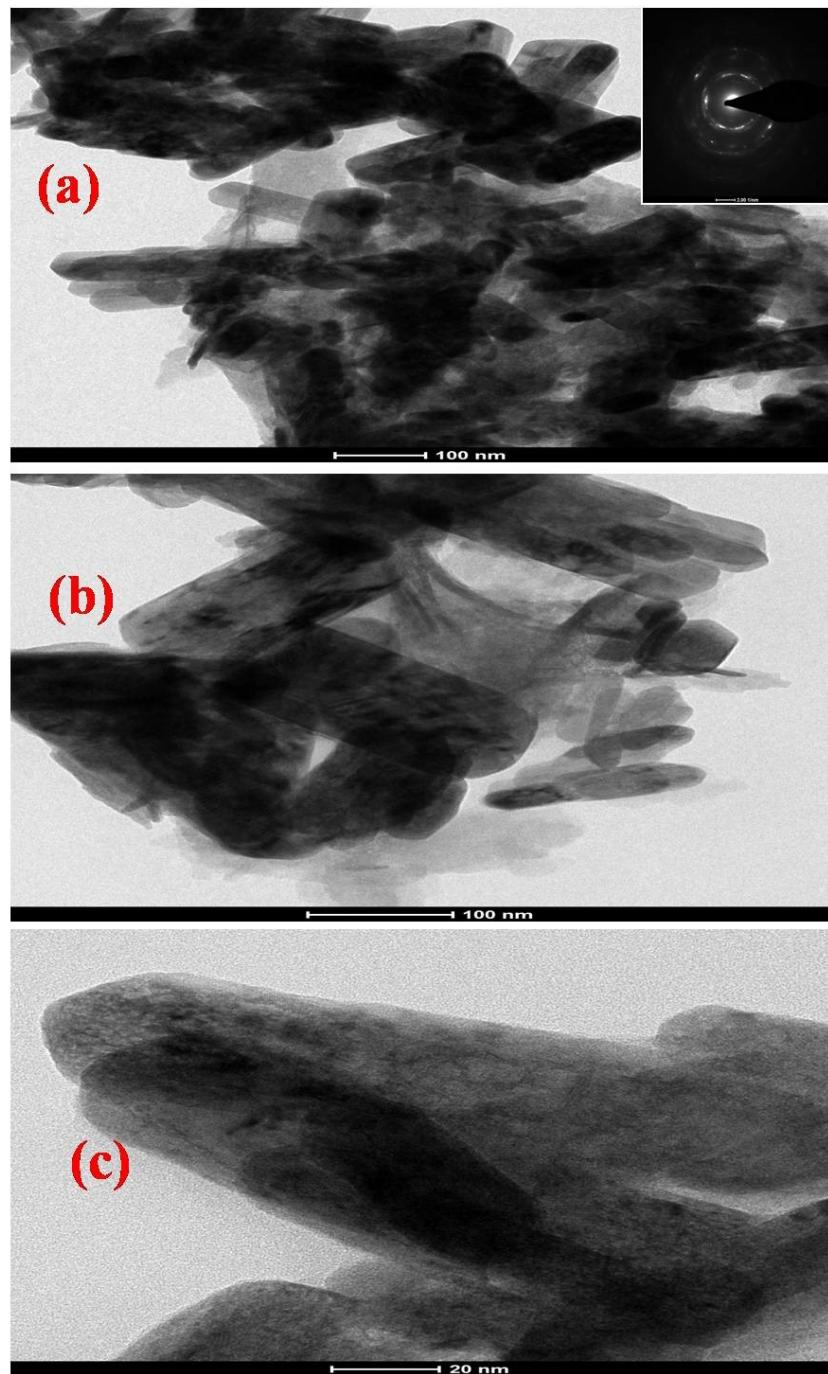


Fig. S4 TEM micrographs of (a) $\text{Na}_x\text{Li}_y\text{Pr}(\text{MoO}_4)_2:\text{Tb}^{3+}$, (b) $\text{Na}_x\text{Li}_y\text{Pr}(\text{MoO}_4)_2:\text{Tb}^{3+}@\text{Arg}$ and (c) $\text{Na}_x\text{Li}_y\text{Pr}(\text{MoO}_4)_2:\text{Tb}^{3+}@\text{Lys}$ ($x=10$ mmol and $y=5$ mmol)

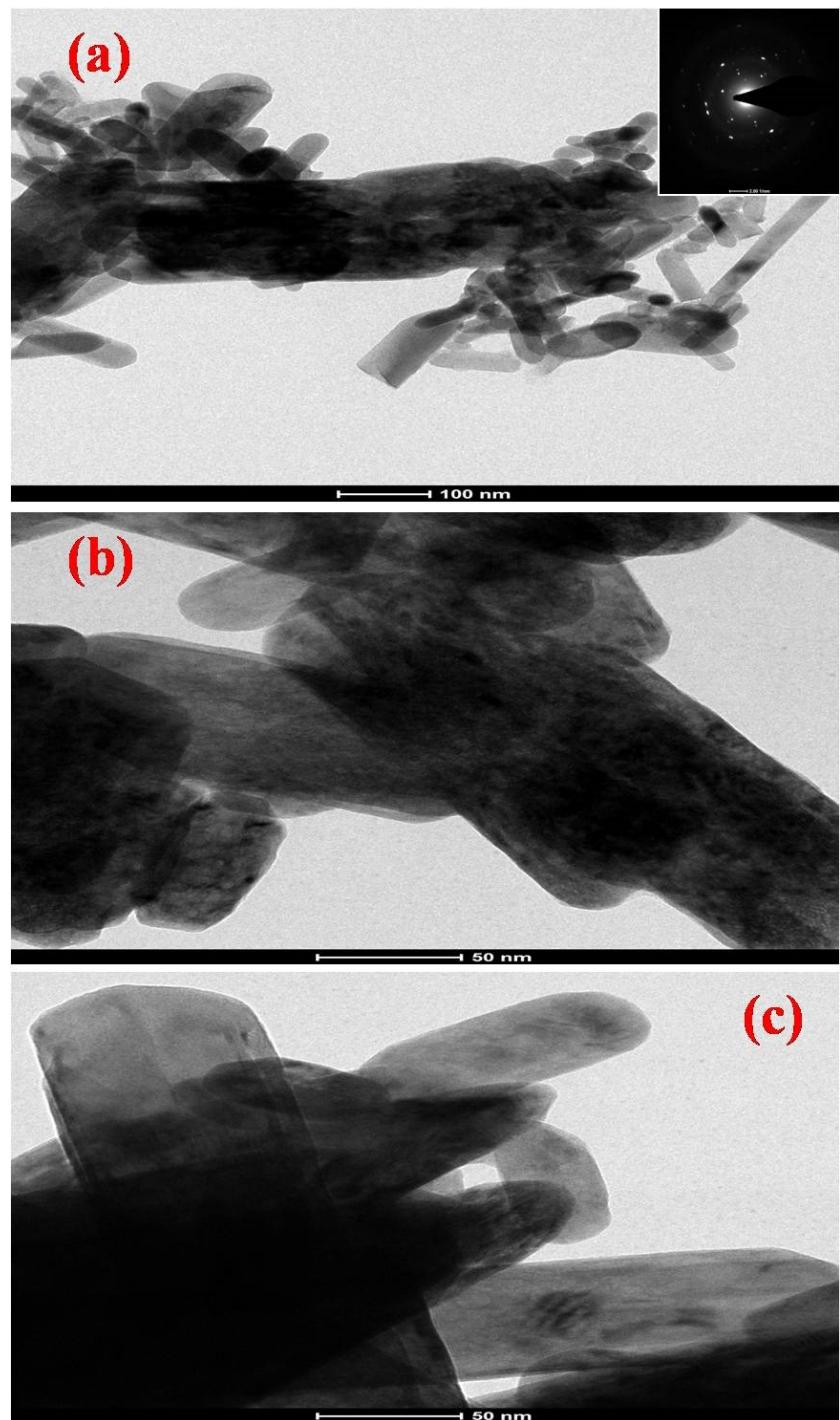


Fig. S5 TEM micrographs of (a) $\text{Na}_x\text{Li}_y\text{Pr}(\text{WO}_4)_2:\text{Tb}^{3+}$, (b) $\text{Na}_x\text{Li}_y\text{Pr}(\text{WO}_4)_2:\text{Tb}^{3+}@\text{Arg}$ and (c) $\text{Na}_x\text{Li}_y\text{Pr}(\text{WO}_4)_2:\text{Tb}^{3+}@\text{Lys}$ ($x=10$ mmol and $y=5$ mmol)

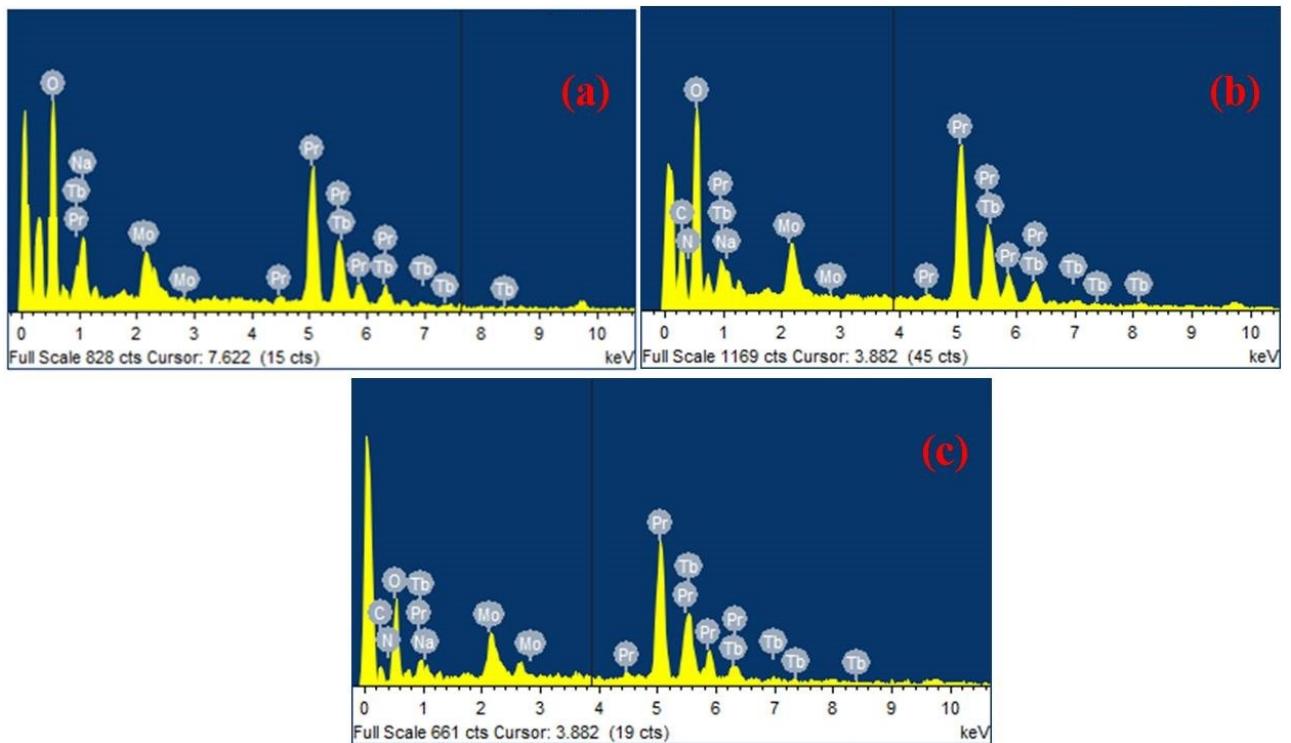


Fig. S6 EDS spectra of (a) $\text{Na}_x\text{Li}_y\text{Pr}(\text{MoO}_4)_2:\text{Tb}^{3+}$, (b) $\text{Na}_x\text{Li}_y\text{Pr}(\text{MoO}_4)_2:\text{Tb}^{3+}@\text{Arg}$ and (c) $\text{Na}_x\text{Li}_y\text{Pr}(\text{MoO}_4)_2:\text{Tb}^{3+}@\text{Lys}$ ($x=10$ mmol and $y=5$ mmol)

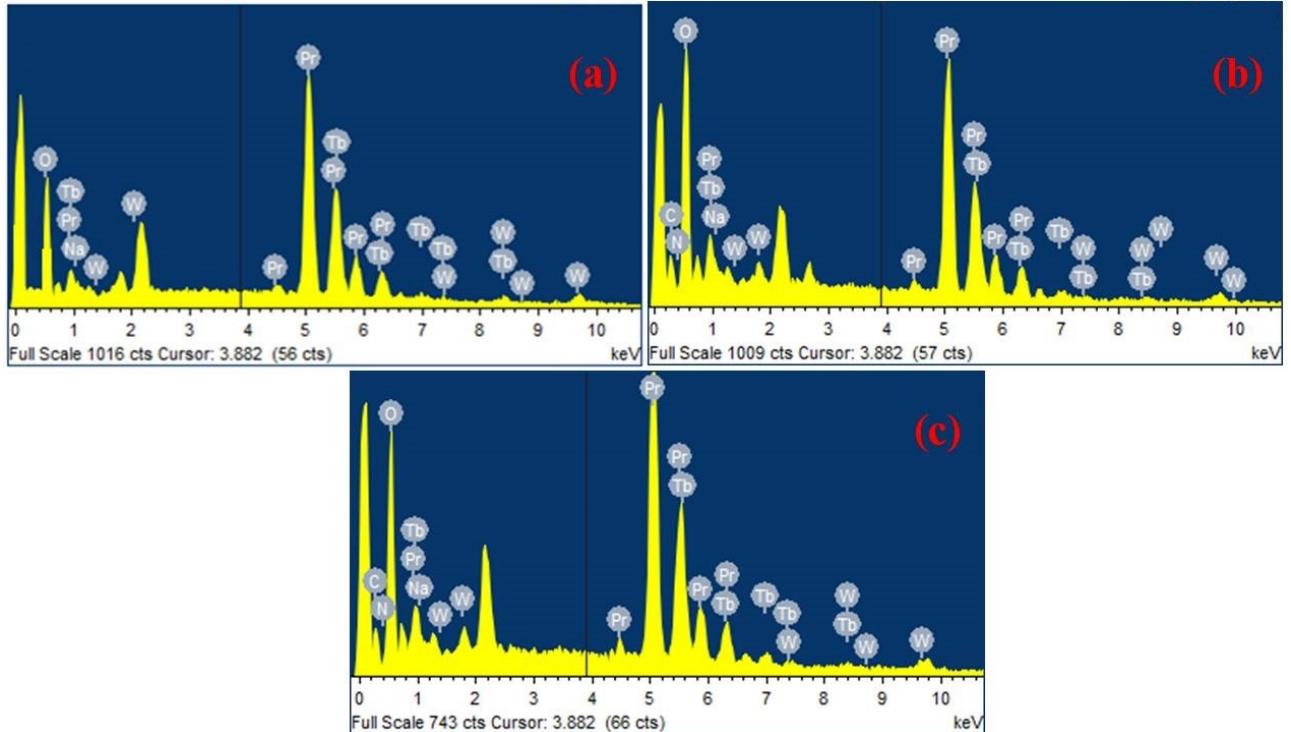


Fig. S7 EDS spectra of (a) $\text{Na}_x\text{Li}_y\text{Pr}(\text{WO}_4)_2:\text{Tb}^{3+}$, (b) $\text{Na}_x\text{Li}_y\text{Pr}(\text{WO}_4)_2:\text{Tb}^{3+}@\text{Arg}$ and (c) $\text{Na}_x\text{Li}_y\text{Pr}(\text{WO}_4)_2:\text{Tb}^{3+}@\text{Lys}$ ($x=10$ mmol and $y=5$ mmol)

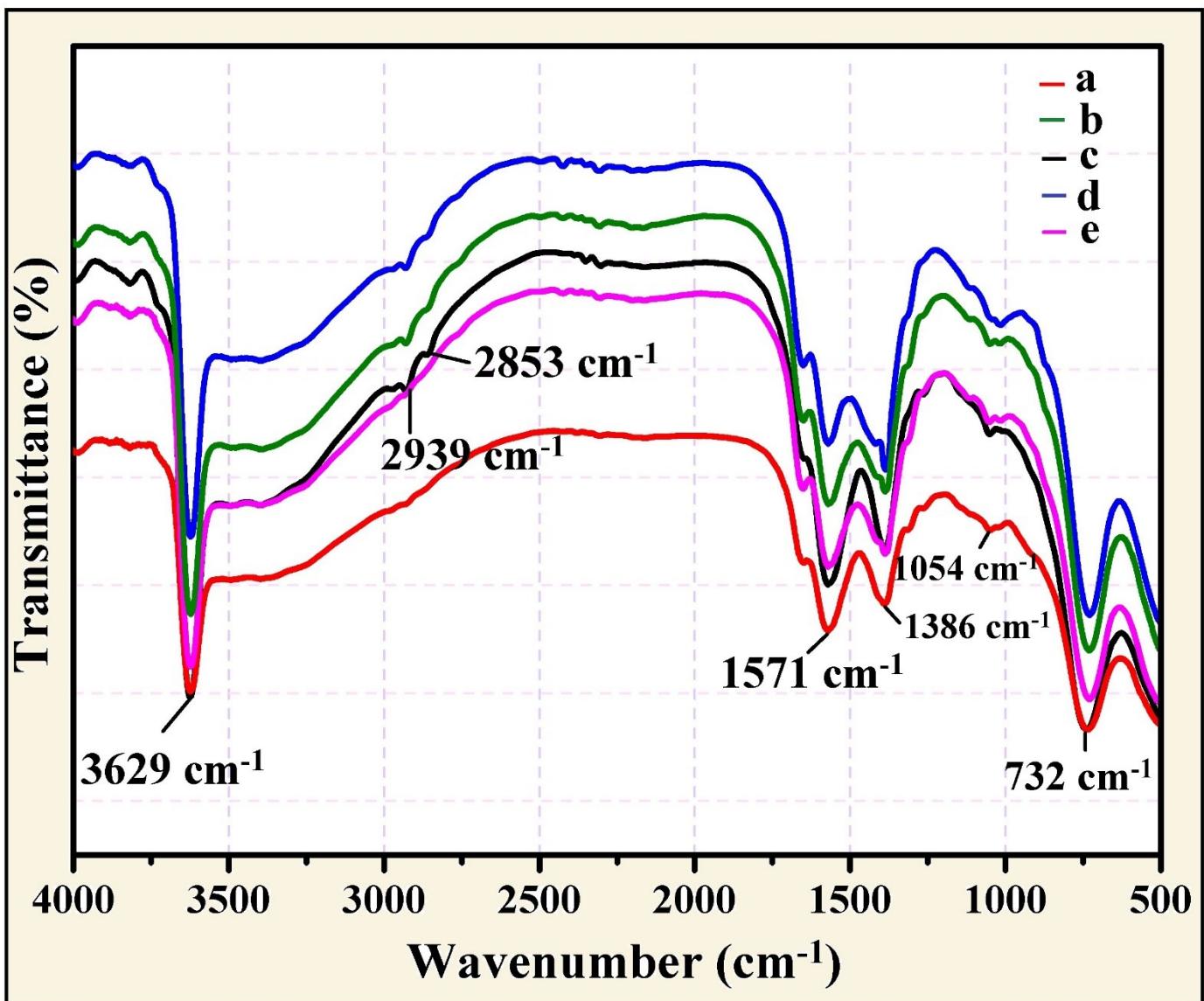


Fig. S8 FT-IR spectra of as-synthesized $\text{Na}_x\text{Li}_y\text{Pr}(\text{MoO}_4)_2:\text{Tb}^{3+}$ nanoparticles with different Li/Na ions concentrations: (Where $x/y =$ (a) $x=15$ mmol $y=0$ mmol, (b) $x=12.5$ mmol, $y=2.5$ mmol, (c) $x=10$ mmol $y=5$ mmol, (d) $x=5$ mmol, $y=10$ mmol and (e) $x=0$ mmol, $y=15$ mmol)

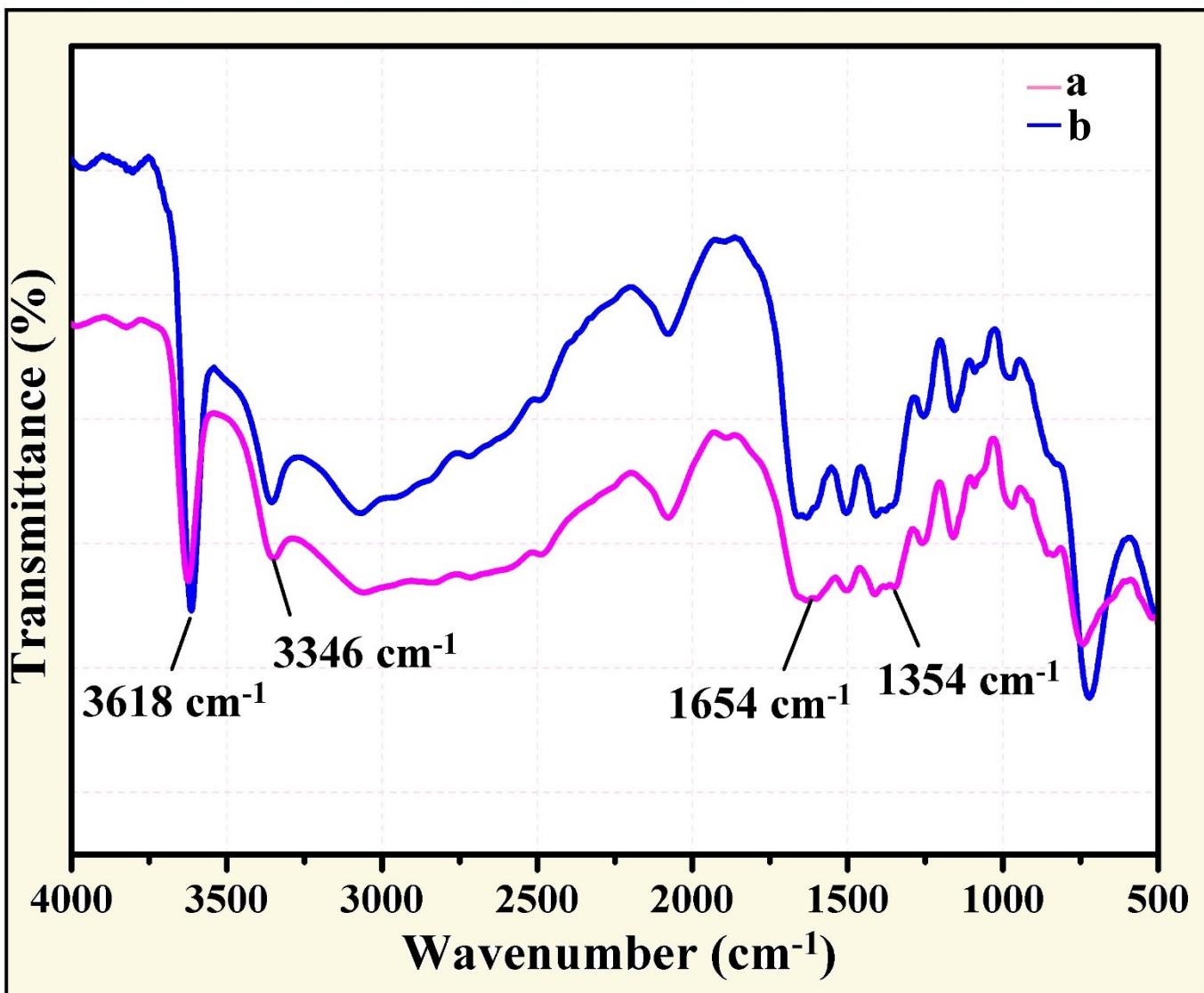


Fig. S9 FT-IR spectra of (a) $\text{Na}_x\text{Li}_y\text{Pr}(\text{MoO}_4)_2:\text{Tb}^{3+}$ @Lys and (b) $\text{Na}_x\text{Li}_y\text{Pr}(\text{MoO}_4)_2:\text{Tb}^{3+}$ @Arg ($x=10$ mmol and $y=5$ mmol)

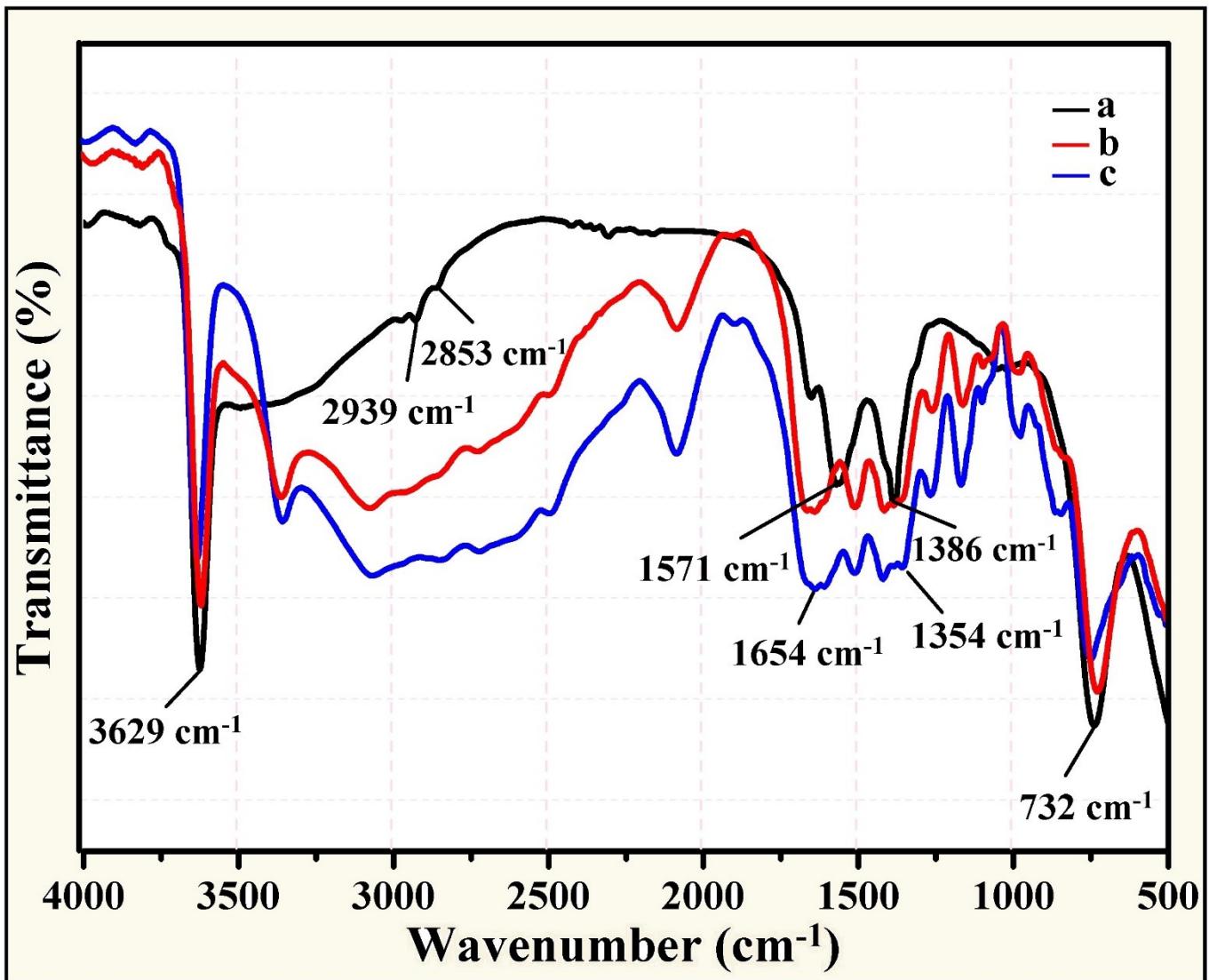


Fig. S10 FT-IR spectra of (a) $\text{Na}_x\text{Li}_y\text{Pr}(\text{WO}_4)_2:\text{Tb}^{3+}$, (b) $\text{Na}_x\text{Li}_y\text{Pr}(\text{WO}_4)_2:\text{Tb}^{3+}@\text{Arg}$ and (c) $\text{Na}_x\text{Li}_y\text{Pr}(\text{WO}_4)_2:\text{Tb}^{3+}@\text{Lys}$ ($x=10$ mmol and $y=5$ mmol)

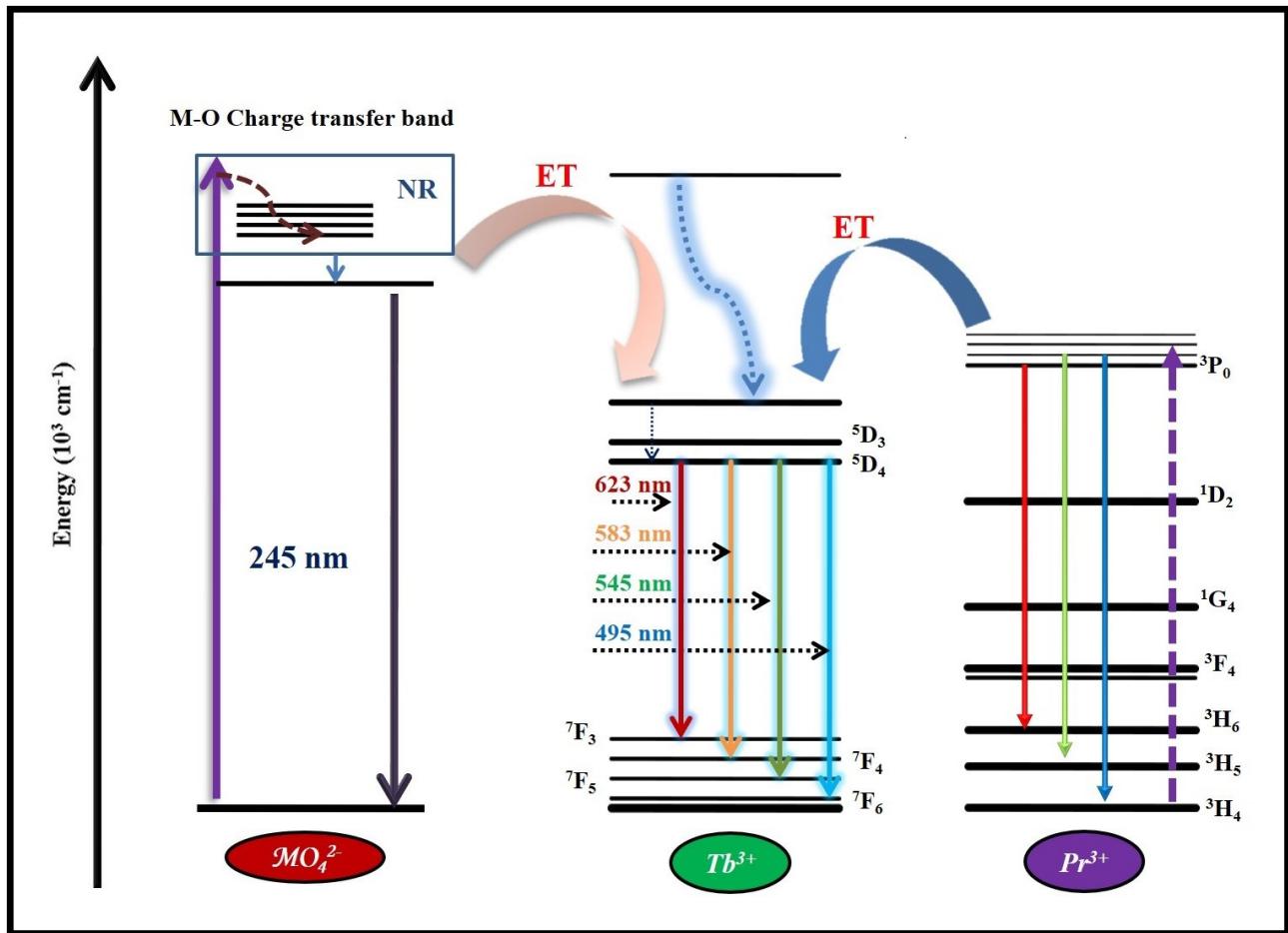


Fig. S11 The plausible energy transfer mechanism involving photoluminescence emission

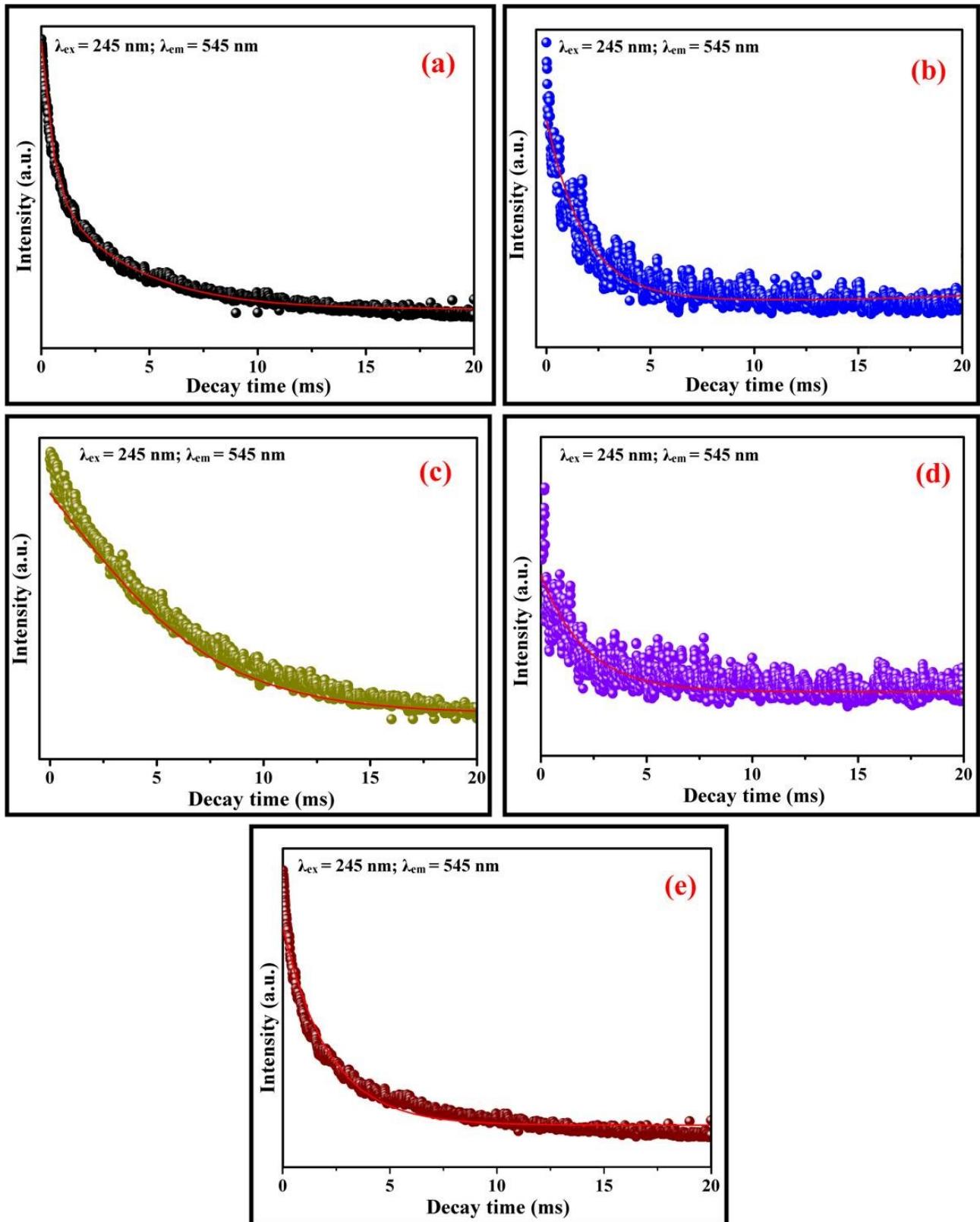


Fig. S12 Decay curves of as-synthesized $\text{Na}_x\text{Li}_y\text{Pr}(\text{MoO}_4)_2:\text{Tb}^{3+}$ nanoparticles with different Li/Na ions concentrations: (Where $x/y =$ (a) $x=15 \text{ mmol}, y=0 \text{ mmol}$, (b) $x=12.5 \text{ mmol}, y=2.5 \text{ mmol}$, (c) $x=10 \text{ mmol}, y=5 \text{ mmol}$, (d) $x=5 \text{ mmol}, y=10 \text{ mmol}$ and (e) $x=0 \text{ mmol}, y=15 \text{ mmol}$)

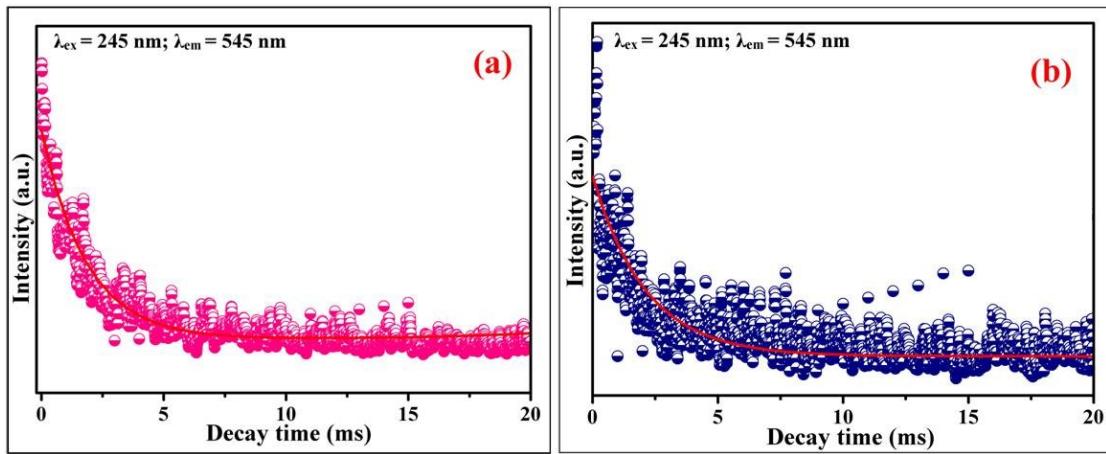


Fig. S13 Decay curves of (a) $\text{Na}_x\text{Li}_y\text{Pr}(\text{MoO}_4)_2:\text{Tb}^{3+}\text{@Lys}$ and (b) $\text{Na}_x\text{Li}_y\text{Pr}(\text{MoO}_4)_2:\text{Tb}^{3+}\text{@Arg}$ ($x=10$ mmol and $y=5$ mmol)

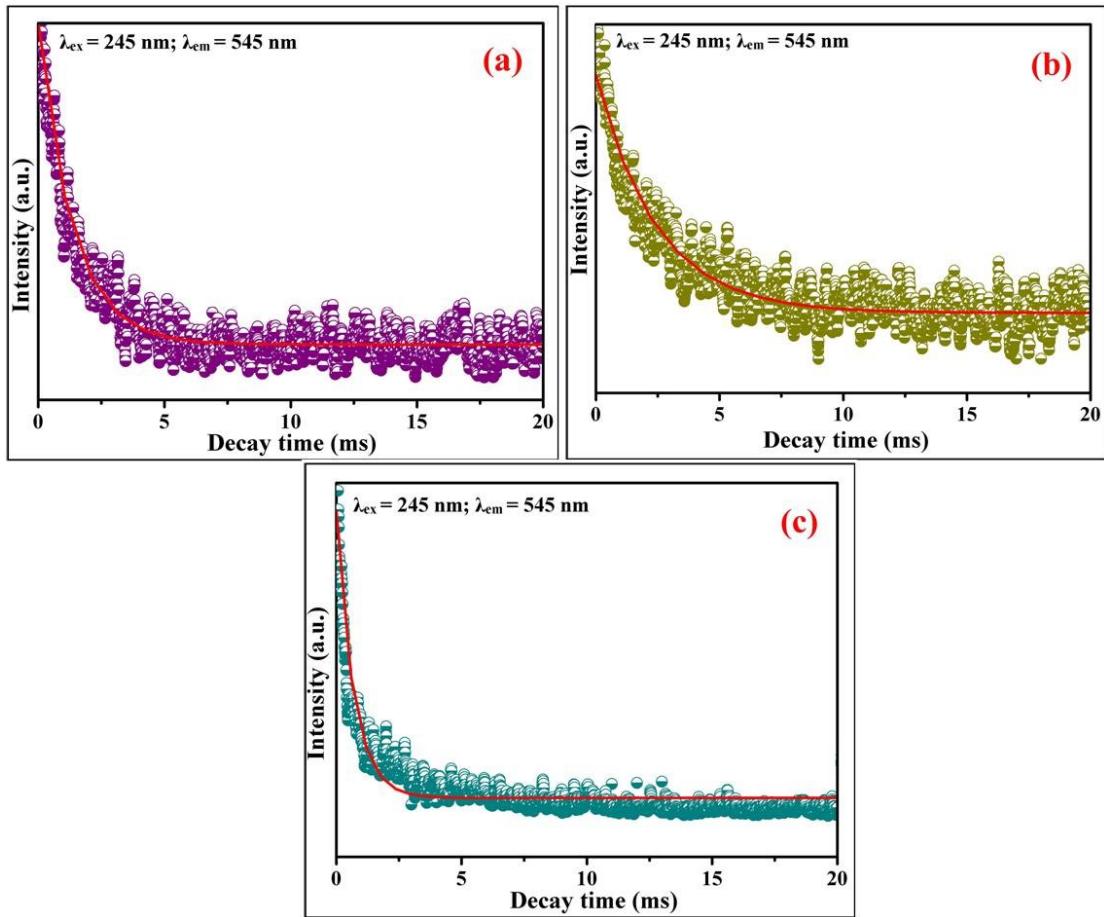


Fig. S14 Decay curves of (a) $\text{Na}_x\text{Li}_y\text{Pr}(\text{WO}_4)_2:\text{Tb}^{3+}$, (b) $\text{Na}_x\text{Li}_y\text{Pr}(\text{WO}_4)_2:\text{Tb}^{3+}\text{@Lys}$ and (c) $\text{Na}_x\text{Li}_y\text{Pr}(\text{WO}_4)_2:\text{Tb}^{3+}\text{@Arg}$ ($x=10$ mmol and $y=5$ mmol)

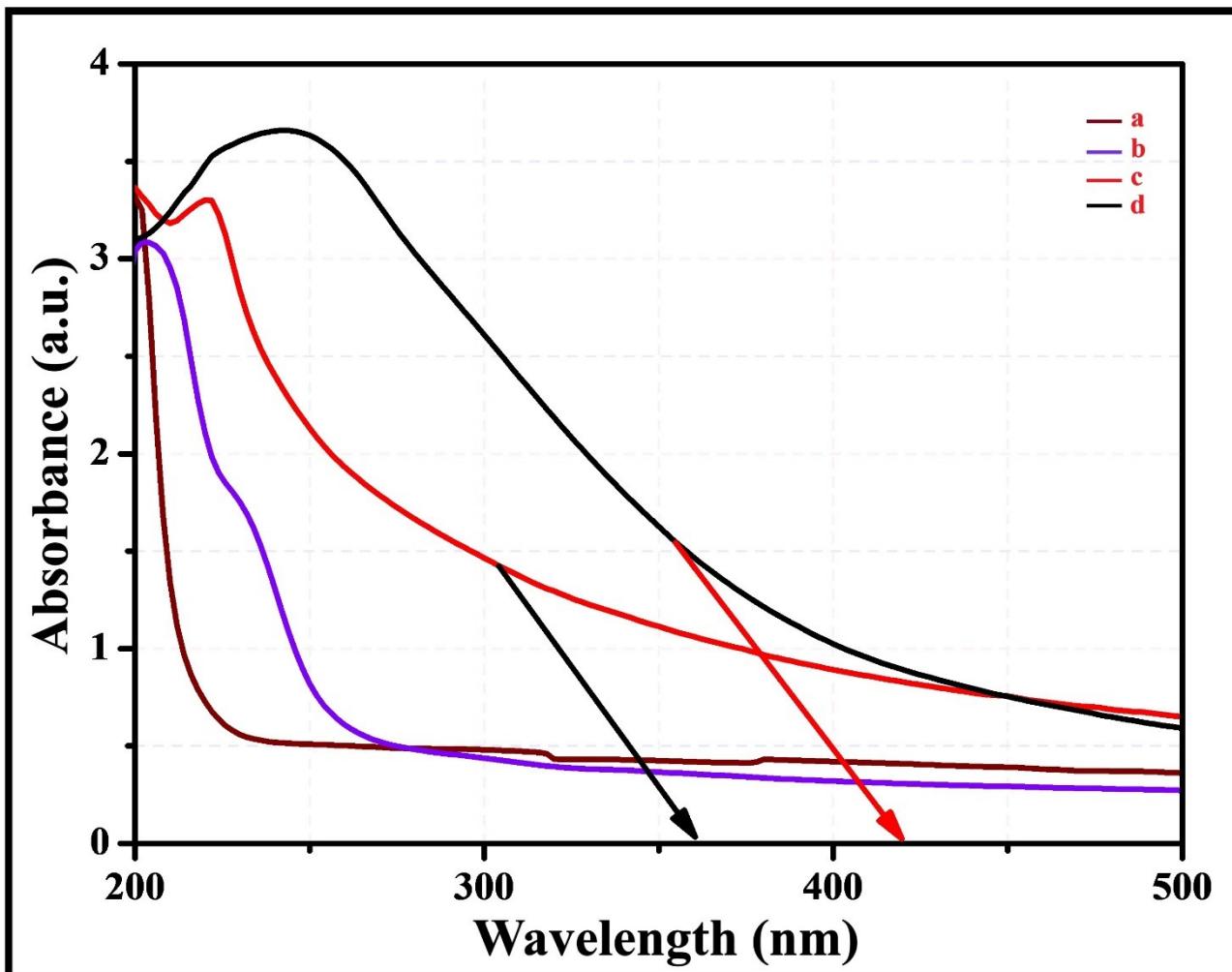


Fig. S15 UV-visible absorption spectra of (a) $\text{Na}_x\text{Li}_y\text{Pr}(\text{MoO}_4)_2:\text{Tb}^{3+}$, (b) $\text{Na}_x\text{Li}_y\text{Pr}(\text{WO}_4)_2:\text{Tb}^{3+}$ (c) $\text{Na}_x\text{Li}_y\text{Pr}(\text{MoO}_4)_2:\text{Tb}^{3+}@\text{Arg}$ and (d) $\text{Na}_x\text{Li}_y\text{Pr}(\text{WO}_4)_2:\text{Tb}^{3+}@\text{Arg}$ ($x=10$ mmol and $y=5$ mmol)

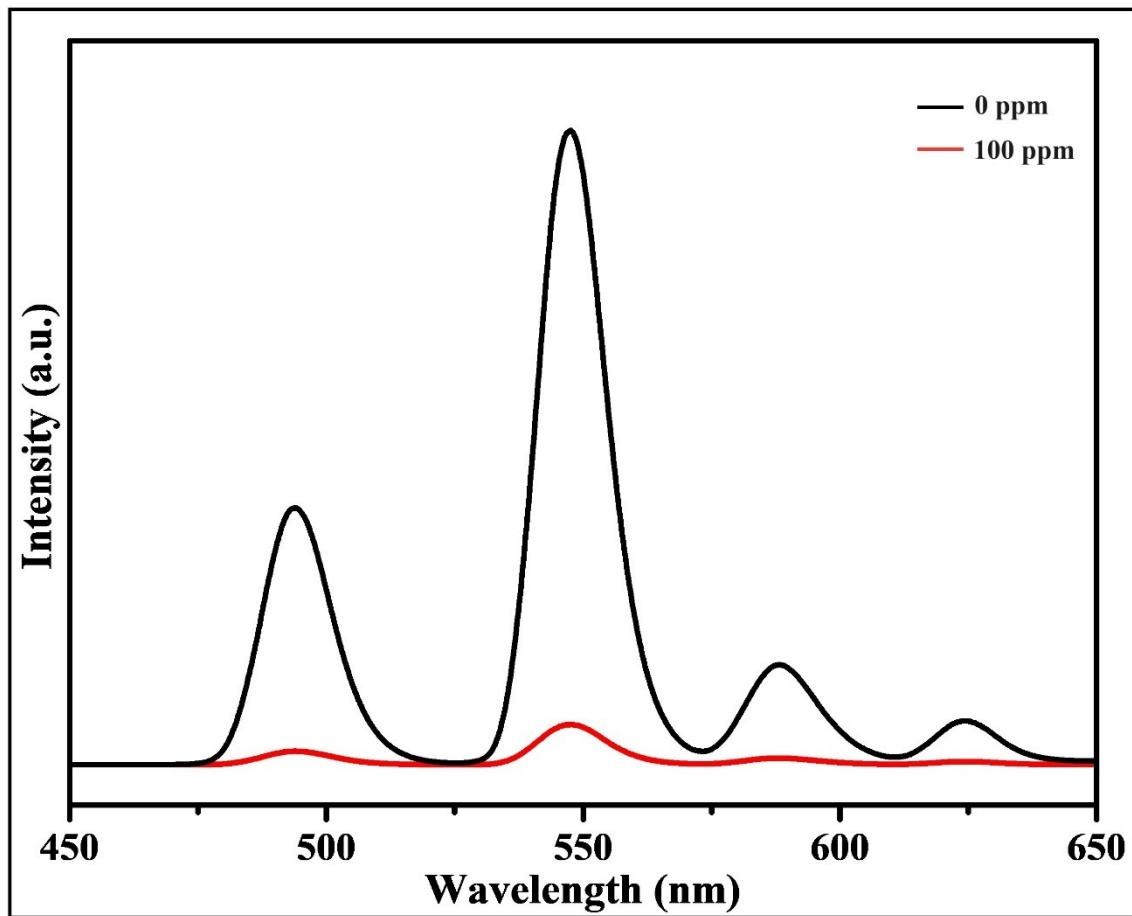


Fig. S16 PL spectra of (a) $\text{Na}_x\text{Li}_y\text{Pr}(\text{MoO}_4)_2:\text{Tb}^{3+}\text{@Arg}$ and (b) $\text{Na}_x\text{Li}_y\text{Pr}(\text{MoO}_4)_2:\text{Tb}^{3+}\text{@Arg} + 100 \text{ ppm of PA}$

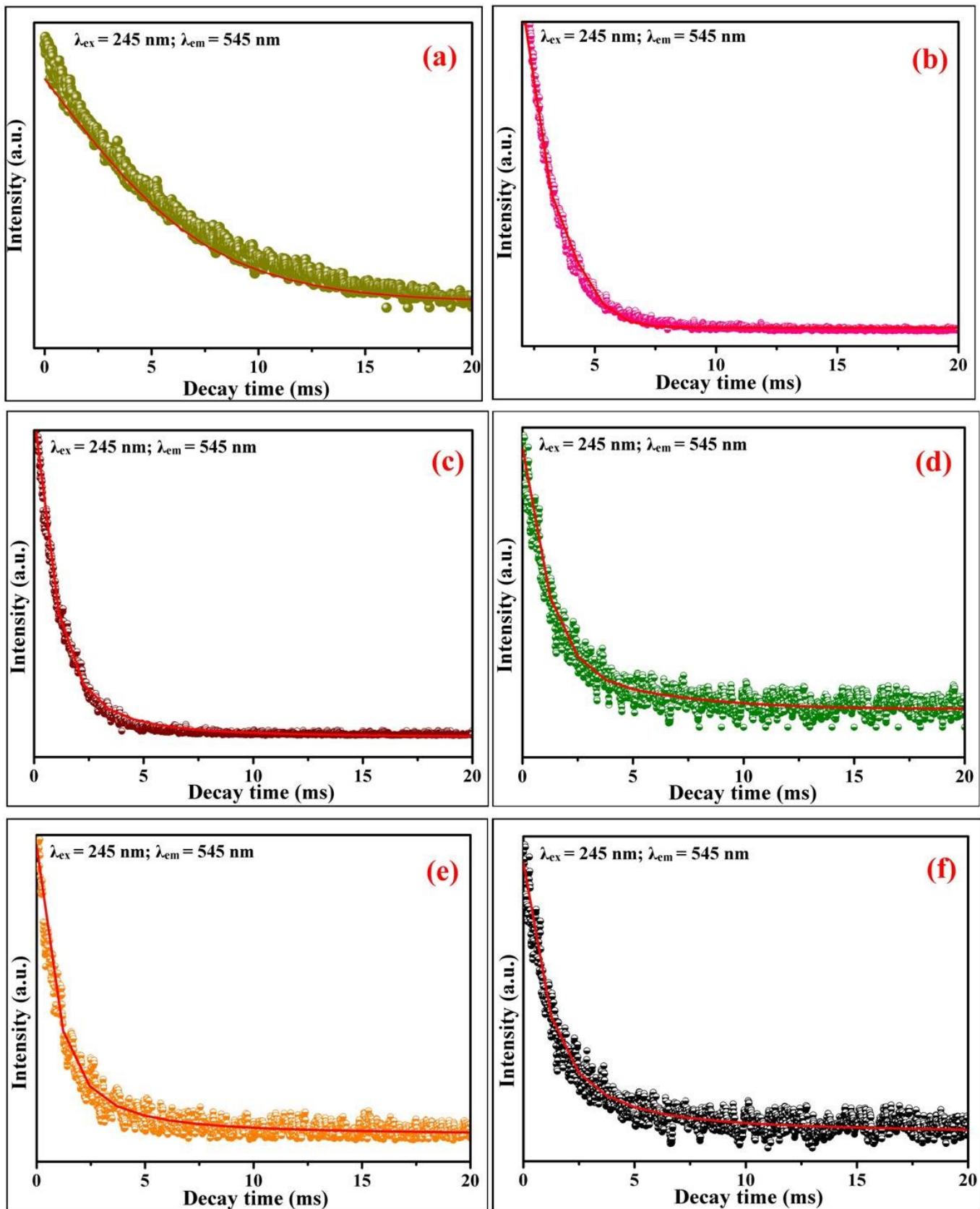


Fig. S17 Time-resolved decay dynamics of $\text{Na}_x\text{Li}_y\text{Pr}(\text{MoO}_4)_2:\text{Tb}^{3+}$ @Arg ($x=10$ mmol and $y=5$ mmol) after excitation at 245 nm in the presence of PA ions (0, 20, 40, 60, 80 and 100 ppm)

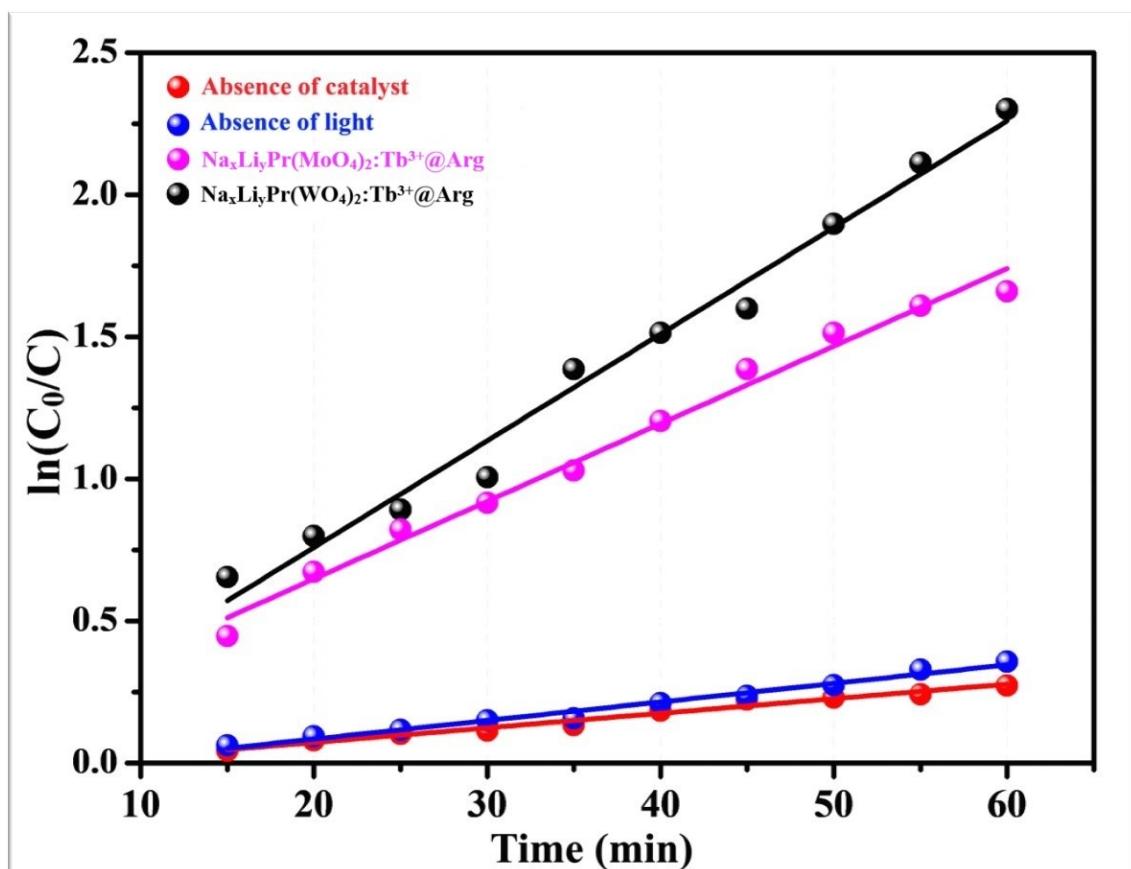


Fig. S18 Pseudo-first order plots of photodegradation of PA by $\text{Na}_x\text{Li}_y\text{Pr}(\text{WO}_4)_2:\text{Tb}^{3+}@\text{Arg}$ and $\text{Na}_x\text{Li}_y\text{Pr}(\text{MoO}_4)_2:\text{Tb}^{3+}@\text{Arg}$ ($x=10$ mmol and $y=5$ mmol) nanocatalysts under UV light irradiation

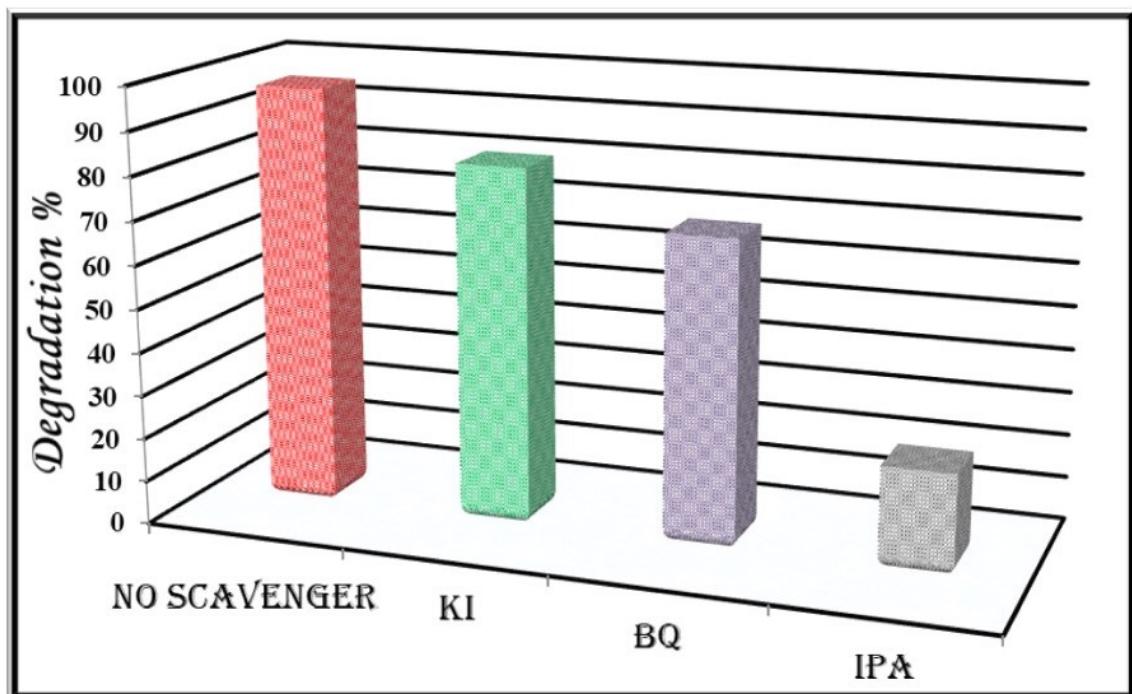
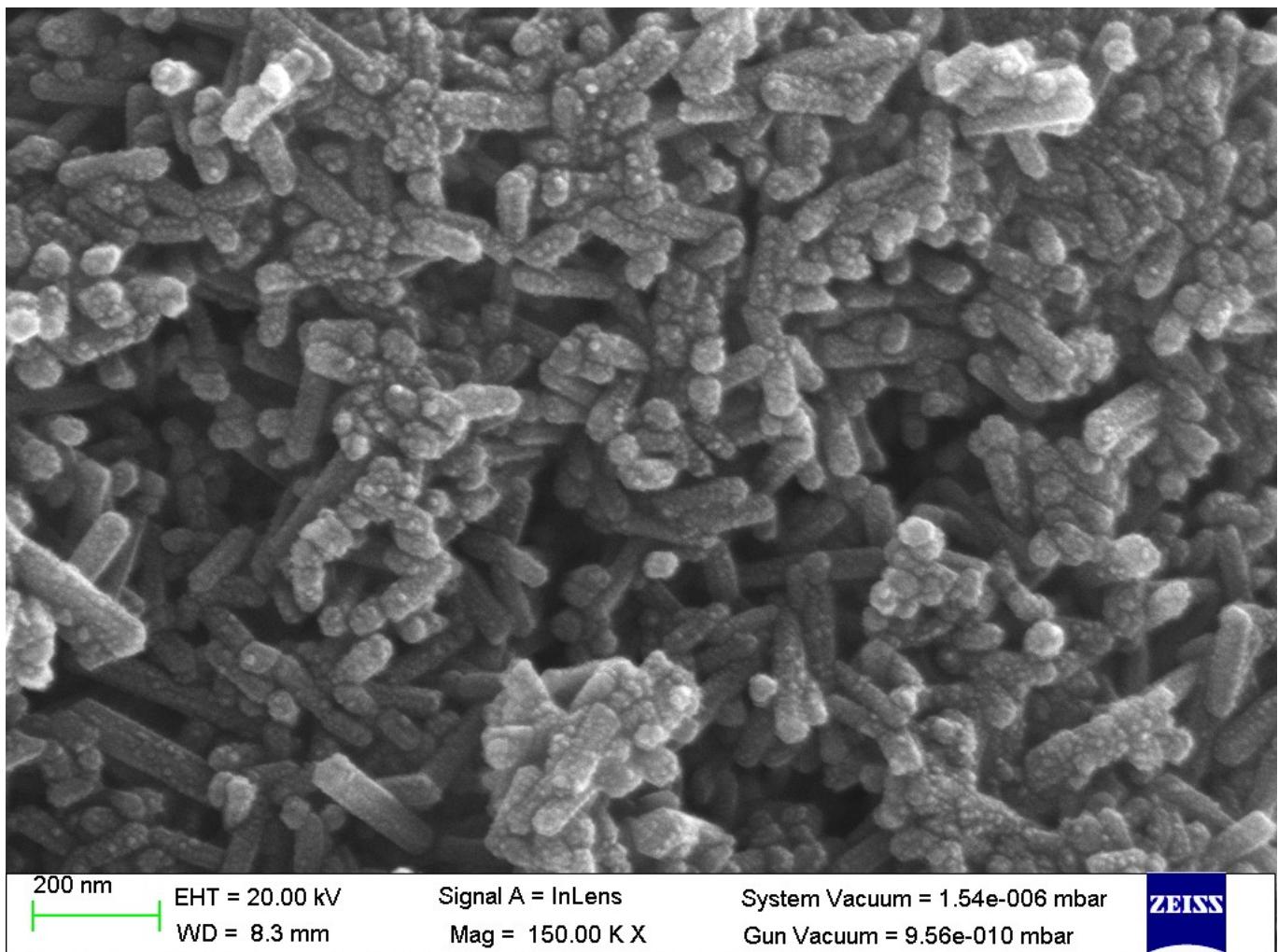


Fig. S19 Scavenger tests of the PA degradation



200 nm
EHT = 20.00 kV
WD = 8.3 mm

Signal A = InLens
Mag = 150.00 K X

System Vacuum = 1.54e-006 mbar
Gun Vacuum = 9.56e-010 mbar



Fig. S20 FE-SEM micrograph of $\text{Na}_x\text{Li}_y\text{Pr}(\text{WO}_4)_2:\text{Tb}^{3+}$ @Arg ($x=10$ mmol and $y=5$ mmol) after photodegradation of PA

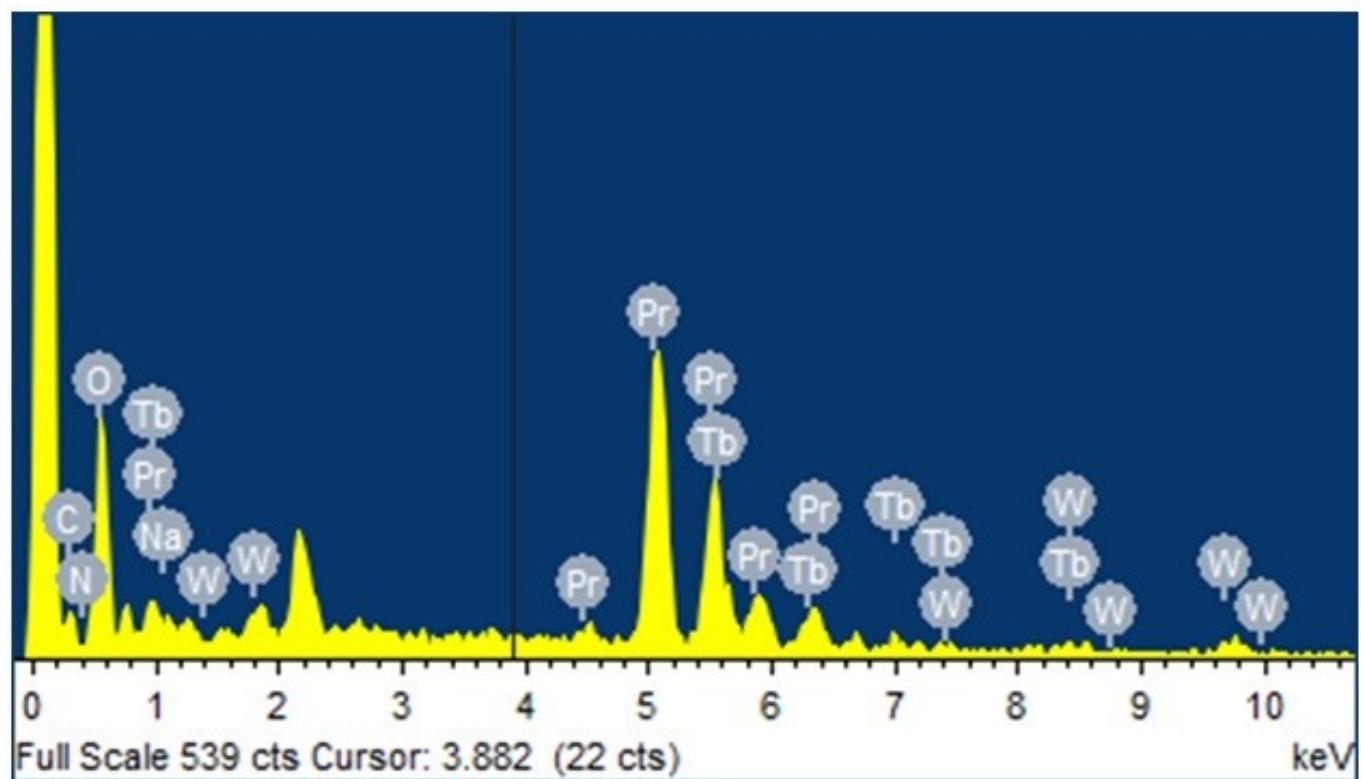


Fig. S21 EDS micrograph of $\text{Na}_x\text{Li}_y\text{Pr}(\text{WO}_4)_2:\text{Tb}^{3+}\text{@Arg}$ ($x=10$ mmol and $y=5$ mmol) after photodegradation of PA

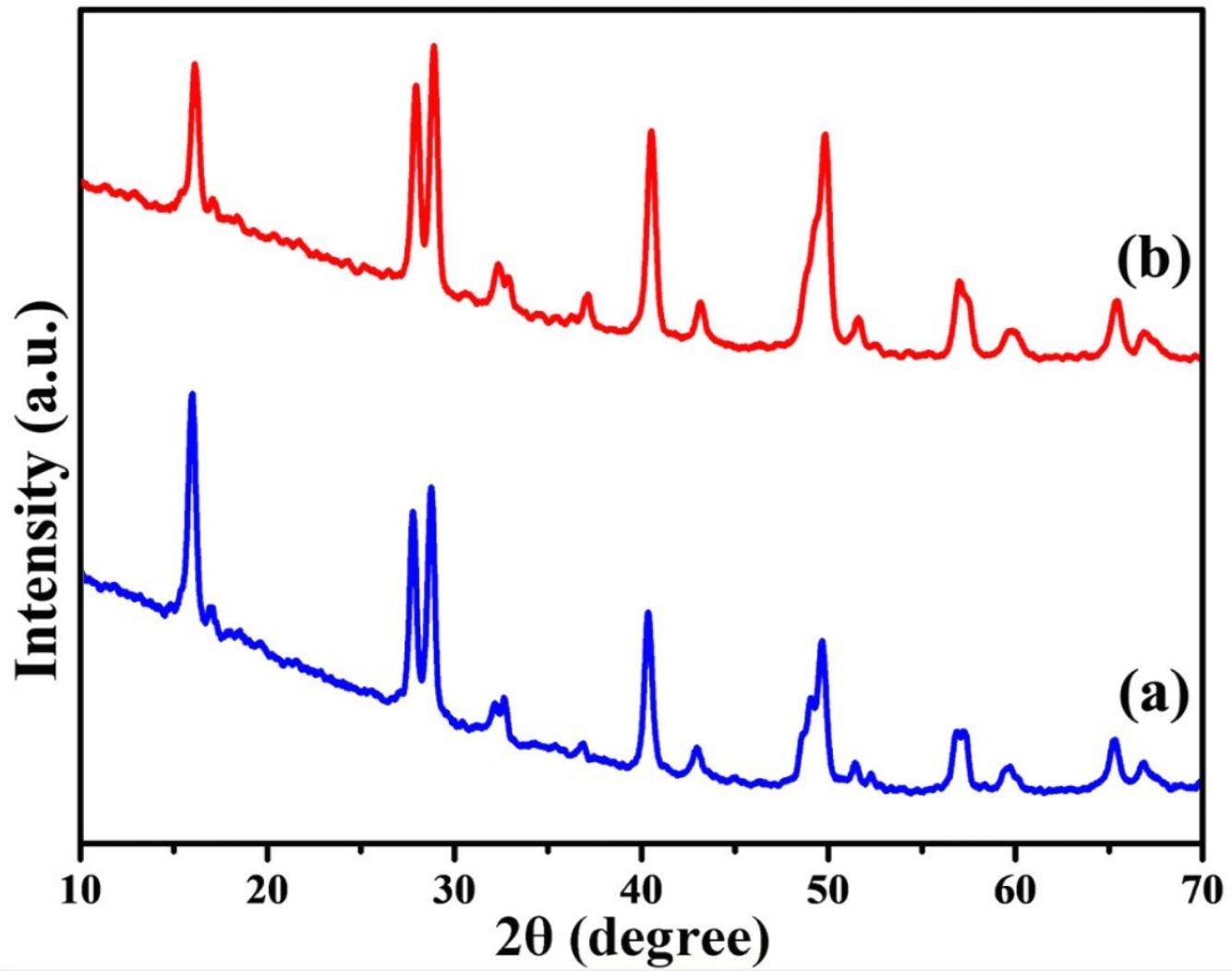


Fig. S22 XRD spectrum of $\text{Na}_x\text{Li}_y\text{Pr}(\text{WO}_4)_2:\text{Tb}^{3+}\text{@Arg}$ ($x=10$ mmol and $y=5$ mmol) (a) before and (b) after photodegradation of PA