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# Upconversion emission enhancement mechanisms of $Nd^{3+}$ sensitized $NaYF_4$: $Yb^{3+}$, $Er^{3+}$ nanoparticles using tunable plasmonic Au films: Plasmonic induced excitation, radiative decays rate and energy transfer enhancement

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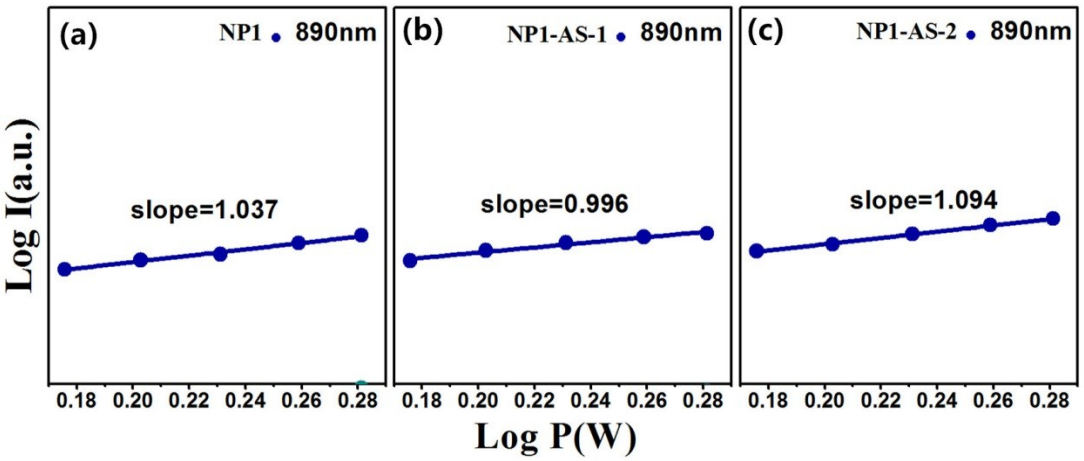


Fig. S1. Dependence of pump power of 808 nm excitation light on 890 nm NIR DWL intensity of $Nd^{3+}$ sensitized $NaYF_4$: $Yb^{3+}$, $Er^{3+}$ nanoparticles deposited on the quartz substrate (a), AS-1 (b) and AS-2(c).

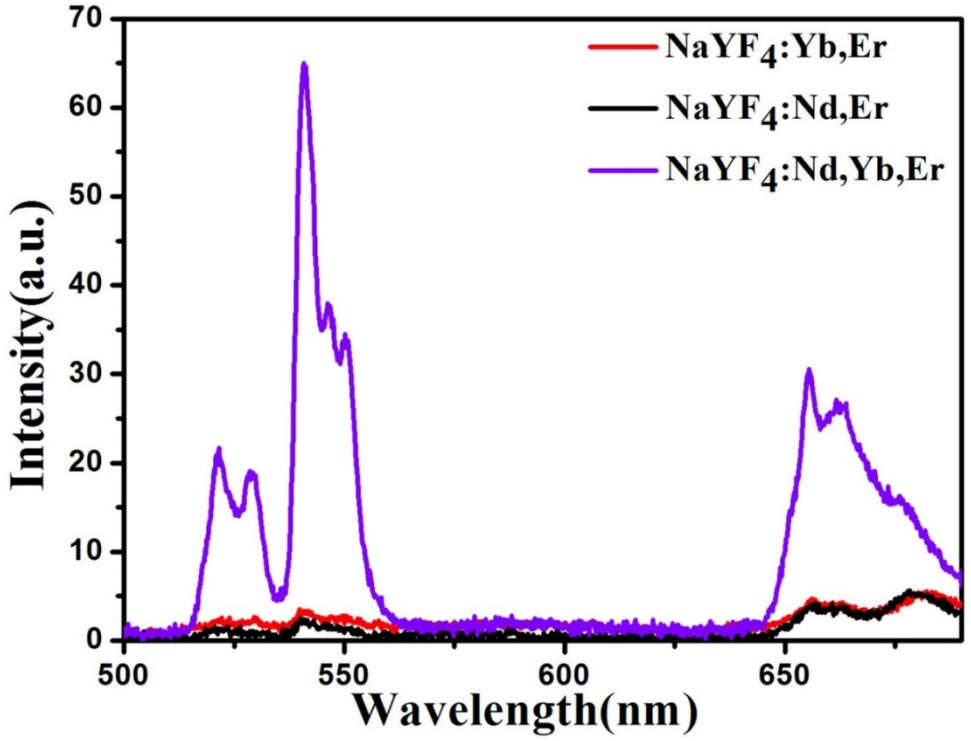


Fig. S2. The UC spectra of the $Nd^{3+}$ sensitized $NaYF_4$: $Er^{3+}$ nanoparticles, the $Yb^{3+}$ sensitized $NaYF_4$: $Er^{3+}$ nanoparticles and the $Nd^{3+}$ sensitized $NaYF_4$: $Yb^{3+}$, $Er^{3+}$ nanoparticles under the excitation of 808 nm

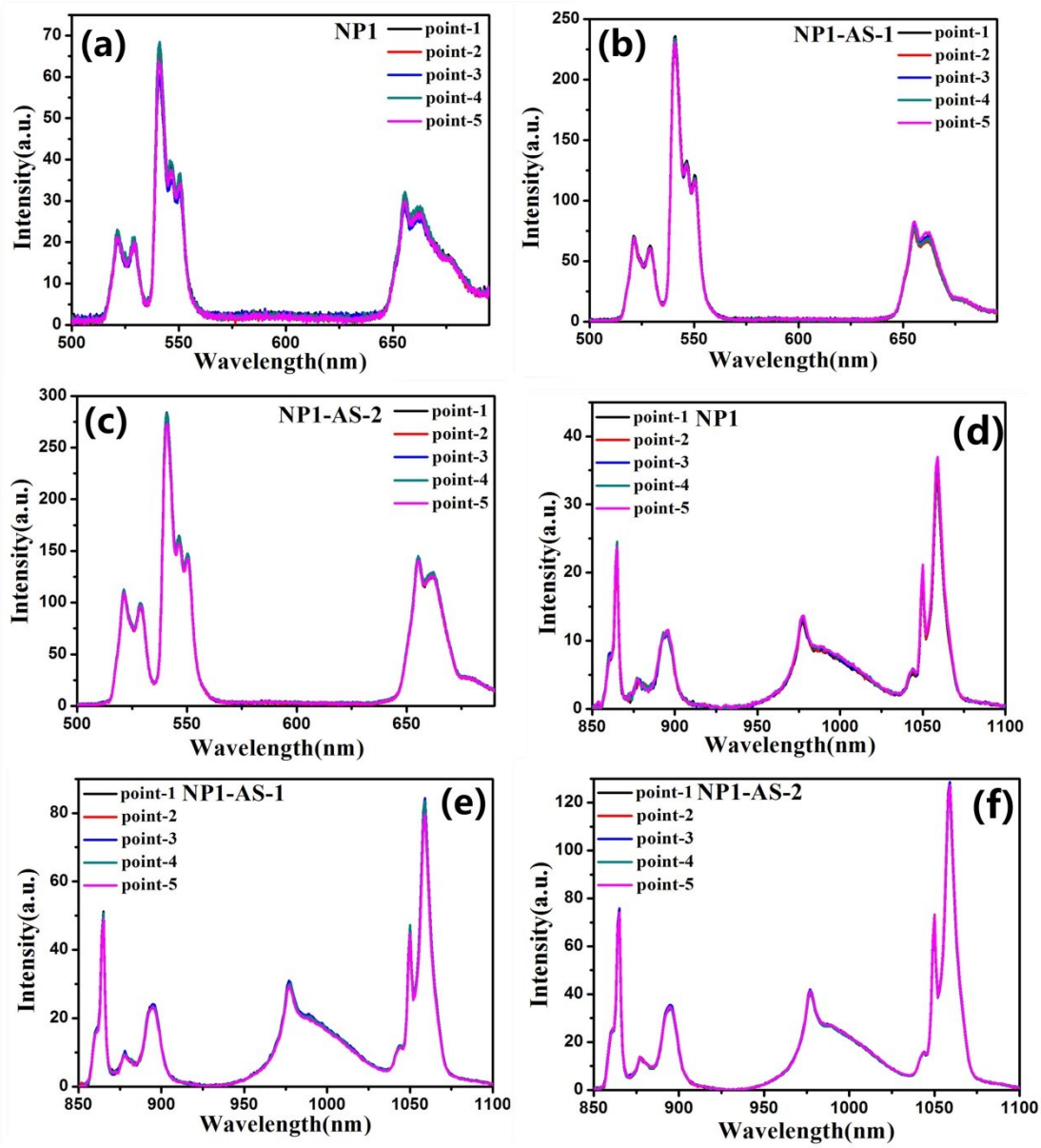


Fig. S3. The UCL and NIR DWL spectra of $NaYF_4$: $Nd^{3+}$, $Yb^{3+}$, $Er^{3+}$ nanoparticles(NP1) from 5 different positions were measured in the three kinds of substrates under the excitation of 808nm

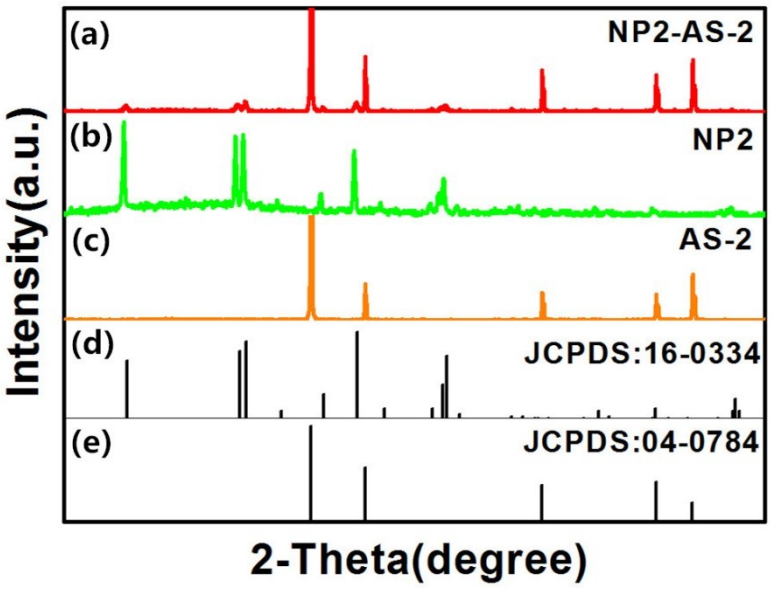


Fig. S4. XRD patterns of β-$NaYF_4$ :$Yb^{3+}$, $Nd^{3+}$ nanoparticles(NP2)/AS-2 Au film nanocomposites (a), the β-$NaYF_4$ :$Yb^{3+}$, $Nd^{3+}$nanoparticles(NP2)(b), the AS-2 Au film in cubic phase (c), the corresponding standard JCPDS card of β-$NaYF_4$(d) and Au cubic phase(e)

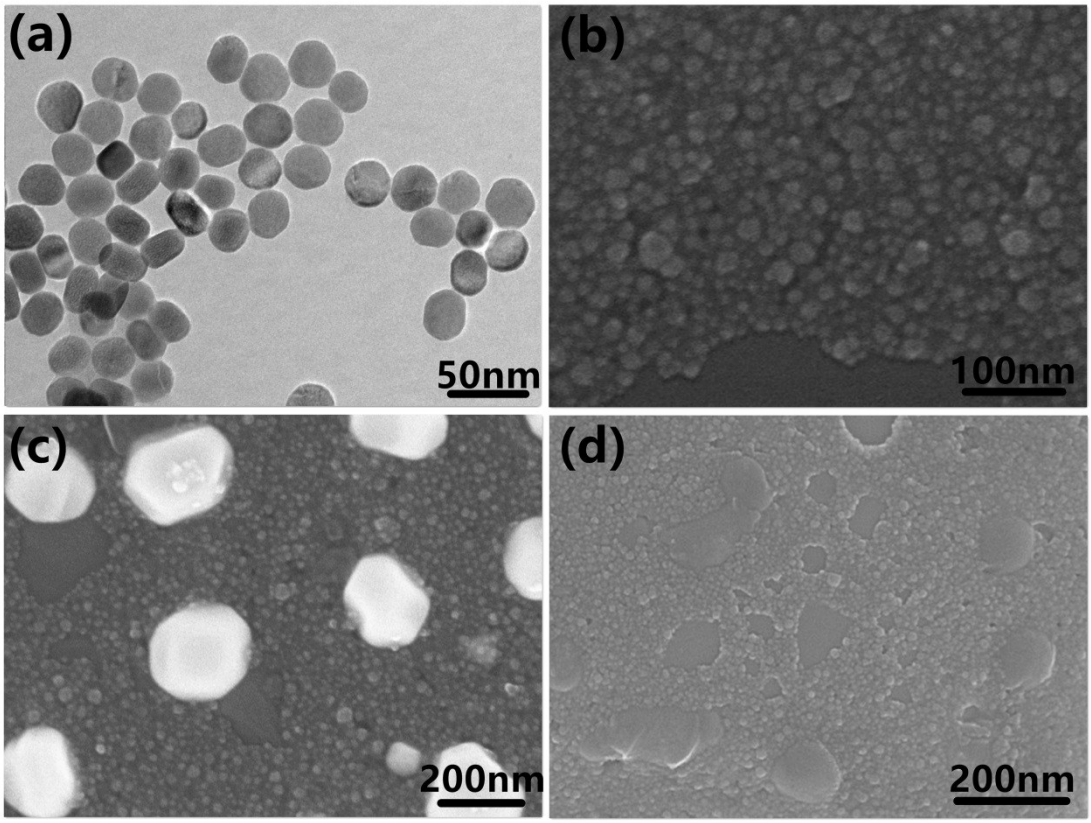


Fig. S5. The TEM image of β-$NaYF_4$: $Nd^{3+}$,$Yb^{3+}$ nanoparticles (a); The SEM images of a single layer of β-$NaYF_4$: $Nd^{3+}$,$Yb^{3+}$ nanoparticles deposited on the quartz

substrate(b), AS-1 Au film (c), and AS-2 Au film (d)

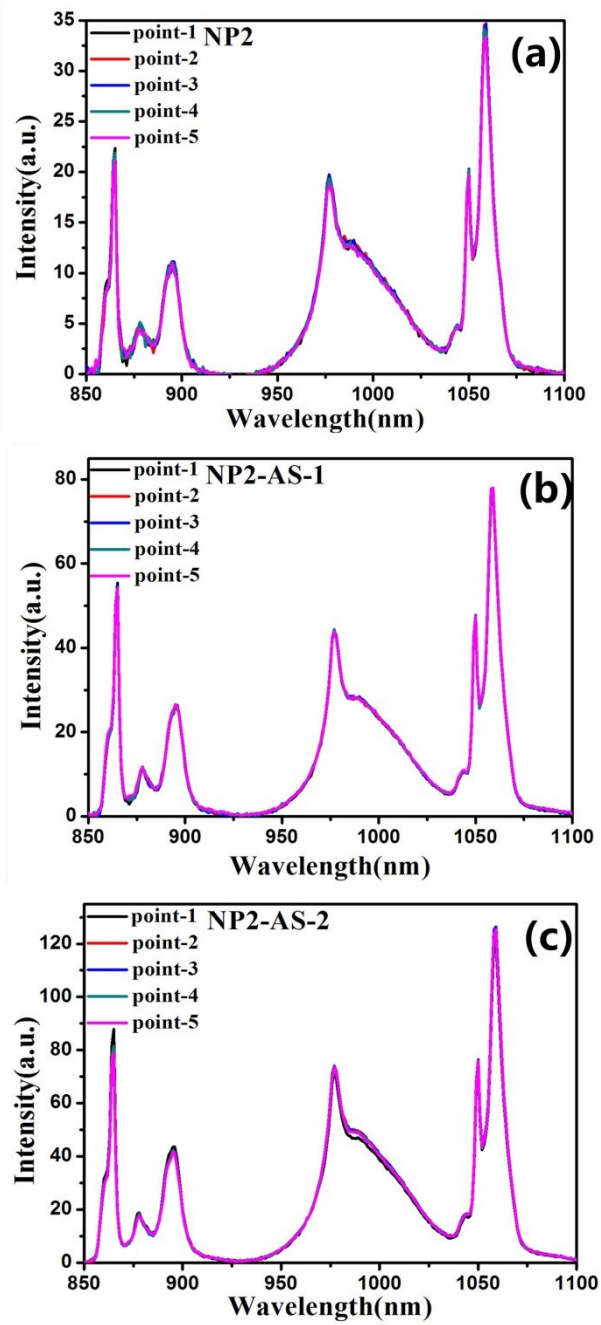


Fig. S6. The NIR DWL spectra of $NaYF_4$: $Nd^{3+}$, $Yb^{3+}$ nanoparticles(NP2) from 5 different positions were measured in the three kinds of substrates under the excitation of 808nm