

Supplementary Information

Depth-profiling of Yb³⁺ sensitizer ions in NaYF₄ upconversion nanoparticles

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SUPPORTING RESULTS:

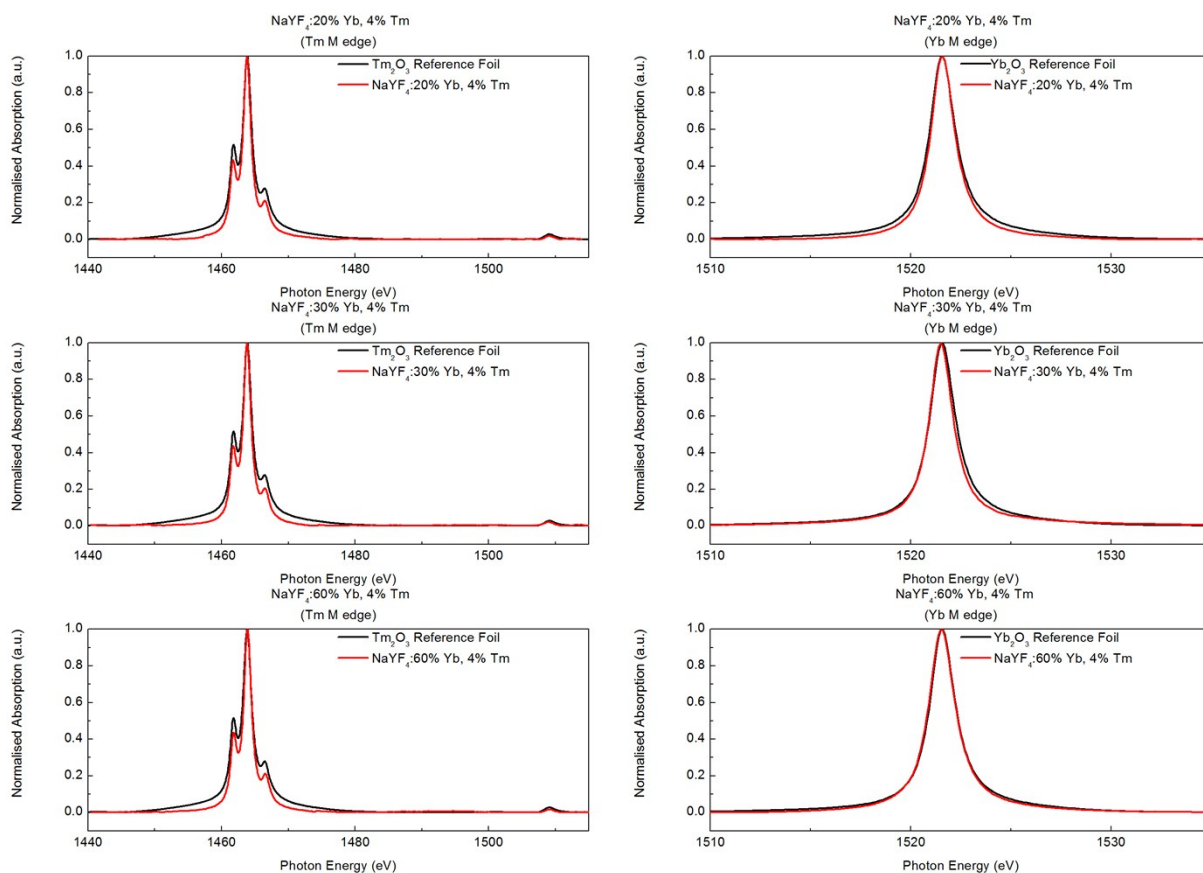


Figure S1. Normalised M-edge NEXAFS spectra of three UCNPs samples plotted together with respective Tm₂O₃ and Yb₂O₃ reference foils, confirming both Yb and Tm ions in the 3+ valence state, which is in the same state as that of host Y ions.

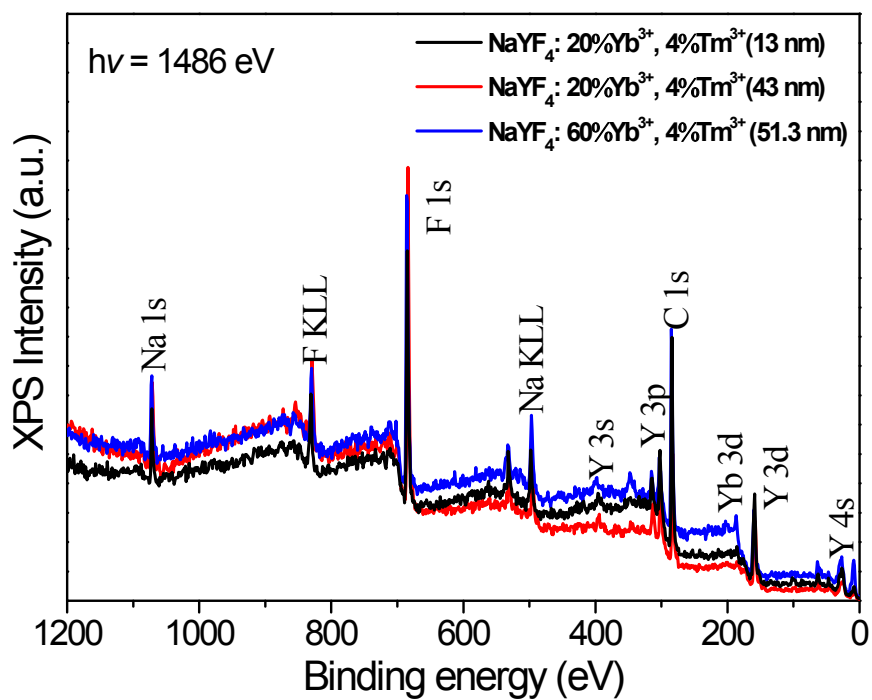


Figure S2. XPS survey spectra for the NaYF₄ UCNP samples acquired at the photon energy of 1486 eV. All the peaks can be identified to the elements in the UCNP.

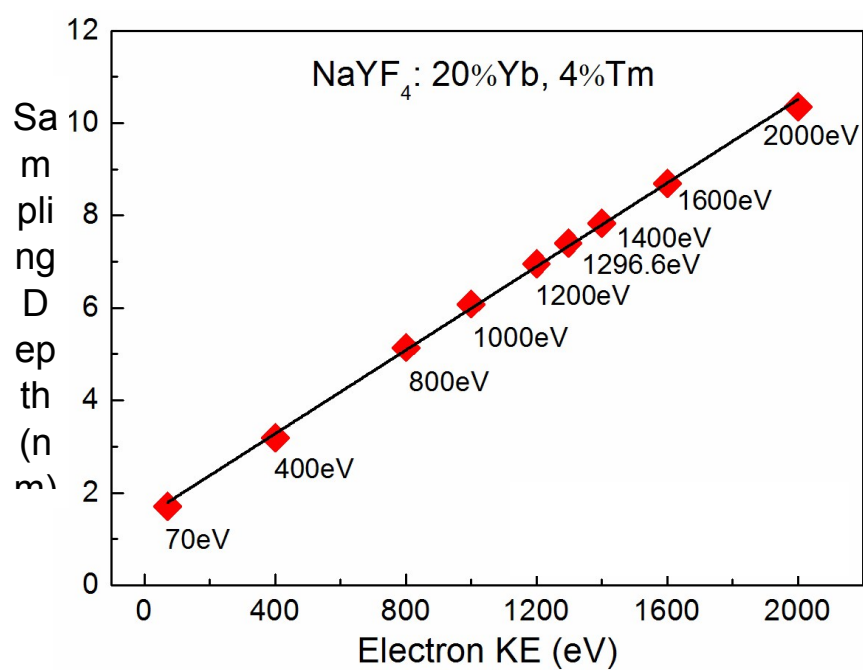


Figure S3. XPS sampling depth in NaYF₄ as a function of photoelectron kinetic energy (KE).

Table S1: Elemental composition of NaYF₄ UCNPs doped with Yb and Tm obtained from ICP-MS analysis.

Size	Designed Composition			Measured Composition		
(nm)	Y ³⁺	Yb ³⁺	Tm ³⁺	Y ³⁺	Yb ³⁺	Tm ³⁺
13.0	76%	20%	4%	76.03%	20.21%	3.75%
26.2				75.52%	20.94%	3.30%
31.1				77.87%	18.23%	3.54%
36.6				78.88%	17.42%	3.90%
43.0				79.62%	17.05%	3.70%
27.4	66%	30%		68.89%	27.60%	3.51%
35.9	51%	45%		53.05%	43.22%	3.74%
51.3	36%	60%		33.48%	63.24%	3.28%