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Supporting Information

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3 A facile synthesis of $\text{NaYF}_4:\text{Yb}^{3+}/\text{Er}^{3+}$ nanoparticles with tunable
4 multicolor upconversion luminescence properties for cell imaging

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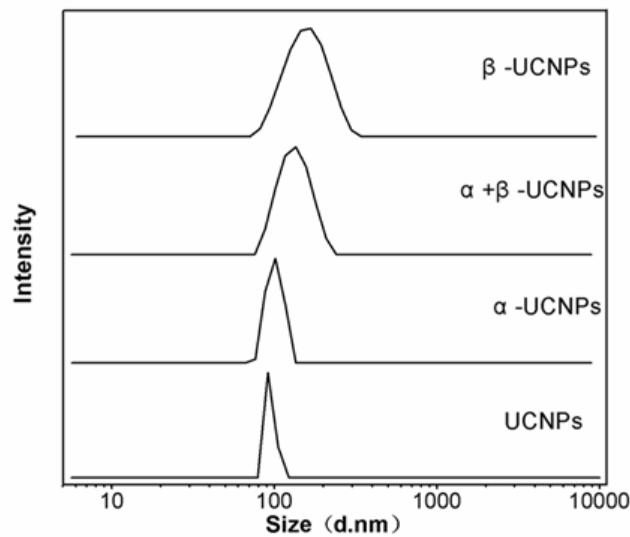
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3 **Fig.S1.** FTIR spectra of UCNPs, PEI, and PEI-UCNPs, inset: The Zeta potential of
4 UCNPs and PEI-UCNPs (UCNPs and PEI-UCNPs were dispersed at the same
5 concentration of 500 μ g/mL in PBS)

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2 **Fig.S2.** The EDX of UCNPs (A) and PEI-UCNPs (B).

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3 **Fig.S3.** The DLS of α -UCNPs, $\alpha + \beta$ -UCNPs, and β -UCNPs.

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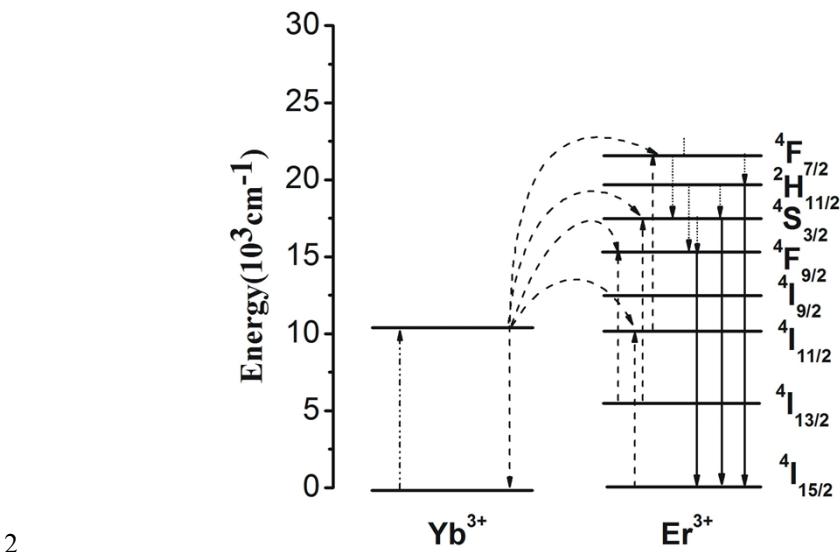
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4 **Fig.S4.** The fluorescence emission spectra of α -UCNPs (A1), α - mixed β -UCNPs

5 (B1), β -UCNPs (C1) and the corresponding chromatic graph (A2, B2, C2).

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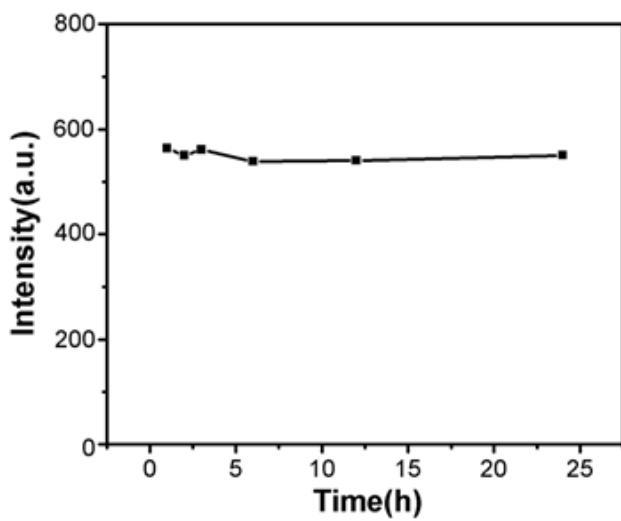
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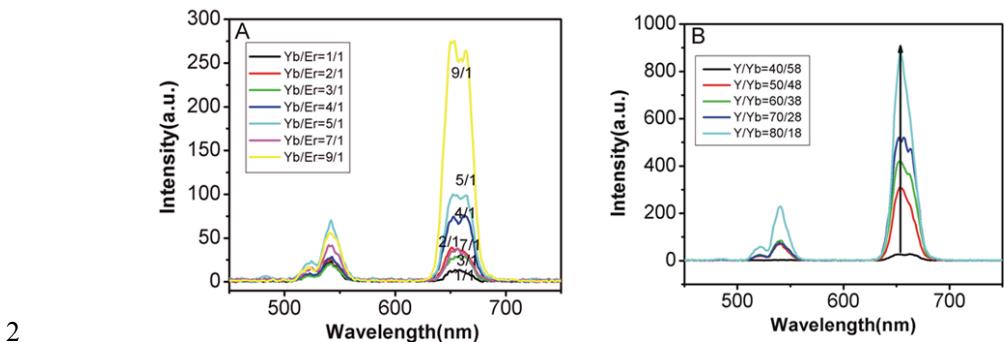
4 **Fig.S5.** Proposed energy-transfer mechanisms showing the upconversion process in
5 Er^{3+} and Yb^{3+} doped crystals under 980 nm laser diode excitation. The dashed-dotted,
6 dashed, dotted, and full arrows represent excitation, energy transfer, multiphonon
7 relaxation, and emission processes, respectively.



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2 **Fig.S6.** The stability of UCNPs in PBS (500 μ g/mL, 0.6A, the intensity was the red
3 emission at 655nm).

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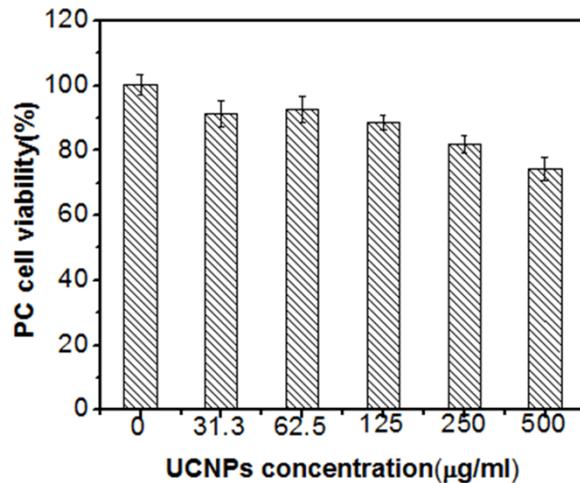


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4 **Fig.S7.** The upconversion emission spectra of (A) $\text{NaYF}_4:\text{Yb}^{3+}/\text{Er}^{3+}$ (Yb/Er=1/1-9/1)
5 and (B) $\text{NaYF}_4:\text{Yb}^{3+}/\text{Er}^{3+}$ (Y/Yb=40/58-80/18).

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5 **Fig.S8.** In vitro cytotoxicity estimation of PC cells by MTT assay after incubation
6 with PEI-UCNPs at different concentrations for 24 h. Error bars were based on three
7 samples.

1 **Table S1** ICP-MS quantitative analysis of three sample' molar ratios of Y:Yb:Er.

Sample	ICP-MS tested results			The molar ratios of Y:Yb:Er
	Y	Yb	Er	
α	20.05%	8.95%	0.91%	79.78%: 18.30%: 1.92%
$\alpha+\beta$	21.10%	9.25%	1.01%	79.96%: 18.01%: 2.03%
β	19.54%	8.46%	0.89%	80.22%: 17.84%: 1.94%

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