

## Supplementary

### NaGdF<sub>4</sub>:Yb, Er, Tm upconversion nanoparticles for bioimaging in shortwave-infrared range: study of energy transfer processes and composition optimization

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The upconversion luminescence efficiency was calculated for the visible range, 500-700 nm, using the method described in [1]. Pumping power density was estimated to be 1 W/cm<sup>2</sup>.

Table s1. The upconversion luminescence efficiency for Yb-Er-Tm tri-doped  $\beta$ -NaGdF<sub>4</sub> nanoparticles, calculated for the visible range.

Sample	Ben, %
NaGdF <sub>4</sub> :Yb-Er-Tm (10:1:0.5)	0.05
NaGdF <sub>4</sub> :Yb-Er-Tm (10:1:0.5)@NaYF <sub>4</sub>	0.49
NaGdF <sub>4</sub> :Yb-Er-Tm (10:1:1)	0.05
NaGdF <sub>4</sub> :Yb-Er (20:2)	0.08
NaGdF <sub>4</sub> :Yb-Er (20:2)@NaGdF <sub>4</sub> :Yb-Tm (30:0.5)	0.20
NaGdF <sub>4</sub> :Yb-Er (20:2)@NaGdF <sub>4</sub> :Yb-Tm (30:0.5)@NaYF <sub>4</sub>	0.46
NaGdF <sub>4</sub> :Yb-Tm (30:0.5)	0.01
NaGdF <sub>4</sub> :Yb-Tm (30:0.5)@NaGdF <sub>4</sub> :Yb-Er (20:2)	0.04
NaGdF <sub>4</sub> :Yb-Tm (30:0.5)@NaGdF <sub>4</sub> :Yb-Er (20:2)@NaYF <sub>4</sub>	0.20
NaGdF <sub>4</sub> :Yb-Tm (30:0.5)	0.01
NaGdF <sub>4</sub> :Yb-Tm (30:0.5)@NaYF <sub>4</sub>	0.06
NaGdF <sub>4</sub> :Yb-Tm (30:0.5)@NaYF <sub>4</sub> @NaGdF <sub>4</sub> :Yb-Er (20:2)	0.08
NaGdF <sub>4</sub> :Yb-Tm (30:0.5)@NaYF <sub>4</sub> @NaGdF <sub>4</sub> :Yb-Er (20:2)@NaYF <sub>4</sub>	0.17

[1] A.V. Ryabova, D.V. Pominova, V.A. Krut'ko, M.G. Komova, V.B. Loschenov. Spectroscopic research of upconversion nanomaterials based on complex oxide compounds doped with rare-earth ion pairs: benefit for cancer diagnostics by upconversion fluorescence and radio sensitive methods. // Photon Lasers Med 2013. 2(2). P. 117–128.]: