Electronic Supporting Information

for

Spectrally Resolved Two-photon Absorption Properties and Switching of Multi-modal Luminescence of NaYF₄:Yb,Er/CdSe Hybrid Nanostructures

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IR spectra

Fig. S1. IR spectra of NaYF₄:Yb,Er/CdSe HNSs and NaYF₄:Yb,Er NPs compared with IR spectra of ligands used during synthesis (oleic acid, stearic acid, oleylamine, tributyl phosphine).
**One-photon spectroscopy and power-dependent measurements**

**Fig. S2.** (a) Room temperature non-calibrated PL spectrum of core NaYF$_4$:20%Yb$^{3+}$,2%Er$^{3+}$ NPs upon 980 nm CW laser diode; (b) log-log plot of integral area of $^4$F$_{9/2} \rightarrow ^4$I$_{15/2}$ electronic transition in the function of 980 nm CW laser intensity – the slope of linear fit is equal 2.6$\pm$0.08, with (1-R$^2$) = 10$^{-3}$.
**Fig. S3.** Absorption and photoluminescence spectra of NaYF$_4$:Yb,Er/CdSe HNSs withdrawn from the reaction vessel after different time intervals and dispersed in chloroform.

**Fig. S4.** Room temperature fluorescence intensity decays of NaYF$_4$:Yb,Er/CdSe HNSs upon excitation with 375 nm, monitored at 650 nm.
Fig. S5. Log-log plot of integral area of $^4F_{9/2} \rightarrow ^4I_{15/2}$ electronic transition in the function of 980 nm CW laser intensity, measured for NaYF$_4$:Yb,Er/CdSe HNSs – the slope of linear fit is equal $2.0\pm 0.3$, with $(1-R^2) = 2.3 \times 10^{-2}$. 
**FRET and luminescence decay measurements**

**Fig. S6.** Room temperature fluorescence intensity decays of $^2H_{11/2}^\rightarrow S_{3/2}^\rightarrow I_{15/2}$ electronic transition for core NaYF$_4$:20$\%$Yb$^{3+},2\%$Er$^{3+}$ NPs and hybrid NaYF$_4$:Yb,Er/CdSe HNSs upon excitation with 980 nm laser diode.

**Fig. S7.** Room temperature fluorescence intensity decays of $^4F_{9/2}^\rightarrow I_{15/2}$ electronic transition for core NaYF$_4$:20$\%$Yb$^{3+},2\%$Er$^{3+}$ NPs and NaYF$_4$:Yb,Er/CdSe HNSs upon excitation with 980 nm laser diode.
X-ray diffraction (XRD) measurements

Fig. S8. Experimental X-ray diffraction patterns of NaYF₄:Yb,Er/CdSe HNSs, core NaYF₄:20%Yb³⁺,2%Er³⁺ NPs, Si sample holder, and the JCPDS standards no. 19-0191 and 77-2042.