

Supporting Information

Tip-Enhanced Upconversion Luminescence in Yb^{3+} - Er^{3+} Codoped NaYF_4 Nanocrystals

Gengxu Chen^{1,2}, Chengjie Ding¹, E Wu^{1,*}, Botao Wu¹, Ping Chen³, Xueting Ci¹, Yan Liu¹, Jianrong Qiu³, and Heping Zeng^{1,*}

¹ State Key Laboratory of Precision Spectroscopy, East China Normal University, Shanghai 200062, China.

² College of Physics and Information Engineering, Fuzhou University, Fuzhou 350116, China.

³ State Key Laboratory of Silicon Materials, Zhejiang University, Hangzhou 310027, China.

*Corresponding authors:

E Wu: E-mail: ewu@phy.ecnu.edu.cn

H. Zeng: E-mail: hpzeng@phy.ecnu.edu.cn

Synthesis of the nanoparticles

According to Reference [1], the $\text{NaYF}_4:\text{Yb}^{3+}/\text{Er}^{3+}$ nanoparticles were synthesized by co-precipitation method. The procedure was as followed:

- a) 0.02 mL methanol and 0.78 mL of YCl_3 (1M), 1 mL of YbCl_3 (0.2 M), 0.2 mL of ErCl_3 (0.1 M) in methanol were added to a 50 mL flask. After homogeneous mixture by a magnetic stirring bar inside the flask, 3 mL oleic acid and 7 mL 1-octadecene were slowly added to the solution and heated the solution to 160 °C for 30 min. Then it was cooled down to room temperature.
- b) Subsequently, 1.4 mL methanol and 1.6 mL of NH_4F (1M), 2 mL of NaOH (0.5M) in methanol were added slowly and the solution was stirred for 30 min. After evaporating the methanol completely, the solution was heated to 300 °C under argon for 1.5 h and cooled down to room temperature.
- c) With the addition of ethanol, the nanoparticles were precipitated. Then they were collected by centrifugation and washed with methanol and ethanol a few times, and finally re-dispersed in cyclohexane.

References

- [1] Wang, F.; Han, Y.; Lim, C. S.; Lu, Y.; Wang, J.; Xu, J.; Chen, H.; Zhang, C.; Hong, M.; Liu, X. Simultaneous phase and size control of upconversion nanocrystals through lanthanide doping. *Nature* **2010**, *463*, 1061-1065.