

Supporting Information

Quantum cutting in nanoparticles producing two green photons

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Experimental details

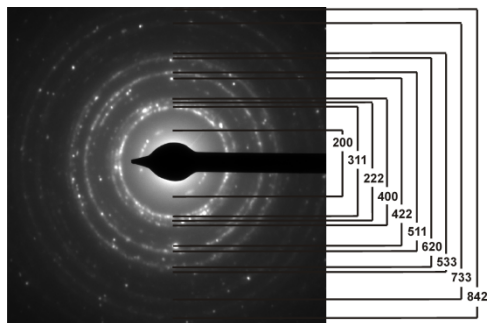
Nanoparticle synthesis. In a typical synthesis, the desired amounts (and in case of doping the desired molar ratios) of lanthanide acetate hydrates and sodium acetate were added to 6 ml of a 1-butyl-3-methylimidazolium tetrafluoroborate and stirred for 2 h in a glovebox until a homogenous suspension was obtained. The reaction mixture was then heated in the microwave (CEM Discover with a frequency of 2455 MHz) for 5 min at 60 °C (in order to facilitate the dissolving process), followed by heating at 200 °C for further 5 min. The power was limited to 300W in order to avoid overheating. The obtained colloidal solution was centrifuged (2000 rpm) and washed several times with 5 ml of a 1:1 volumetric mixture of dichloromethane and ethanol. Finally, the obtained powder was dried at 70 °C for 48 h.

Powder X-ray diffraction. PXRD measurements were performed by using a G670 diffractometer operating with MoK α radiation and equipped with an image plate-detector (Huber, Rimsting, Germany). The powders were sealed in 0.5 mm Lindemann capillaries under argon.

Transmission electron microscopy. Electron micrographs were obtained on a Tecnai G20 HRTEM transmission electron microscope (Fei, Hillsboro, USA). An acceleration voltage of 200 kV was applied. For sample preparation, a small amount of the sample was dispersed in ethanol and dropped on the TEM-Grid (Mesh 300, Plano[®], Wetzlar, Germany).

Luminescence measurements. Luminescence measurements were conducted by using a Fluorolog FL 3-22 spectrophotometer (Horiba JobinYvon, Unterhachingen, Germany) equipped with a continuous xenon lamp for steady-state measurements and a pulsed xenon lamp for obtaining decay curves. Double gratings for the excitation and emission spectrometer were used as monochromators. The signal was detected by using a photomultiplier. For the measurements, powdered samples were filled in silica tubes and carefully positioned in the incoming beam in the sample chamber.

Synchrotron radiation measurements. VUV spectroscopic measurements with synchrotron radiation were undertaken on beamline I (SUPERLUMI station) at the Hamburger Synchrotronstrahlungslabor (HASYLAB), Deutsches Elektronensynchrotron (DESY), Germany. For more information see http://hasylab.desy.de/facilities/doris_iii/beamlines/e6259/index_eng.html.



SI-Figure 1. Electron diffraction pattern of synthesized NaGdF_4 : Er 1.5 %, Tb 0.3 % particles (ErTb₂).