Effects of laser heating on luminescent properties of Gd_2O_3:Er,Yb nanophosphor

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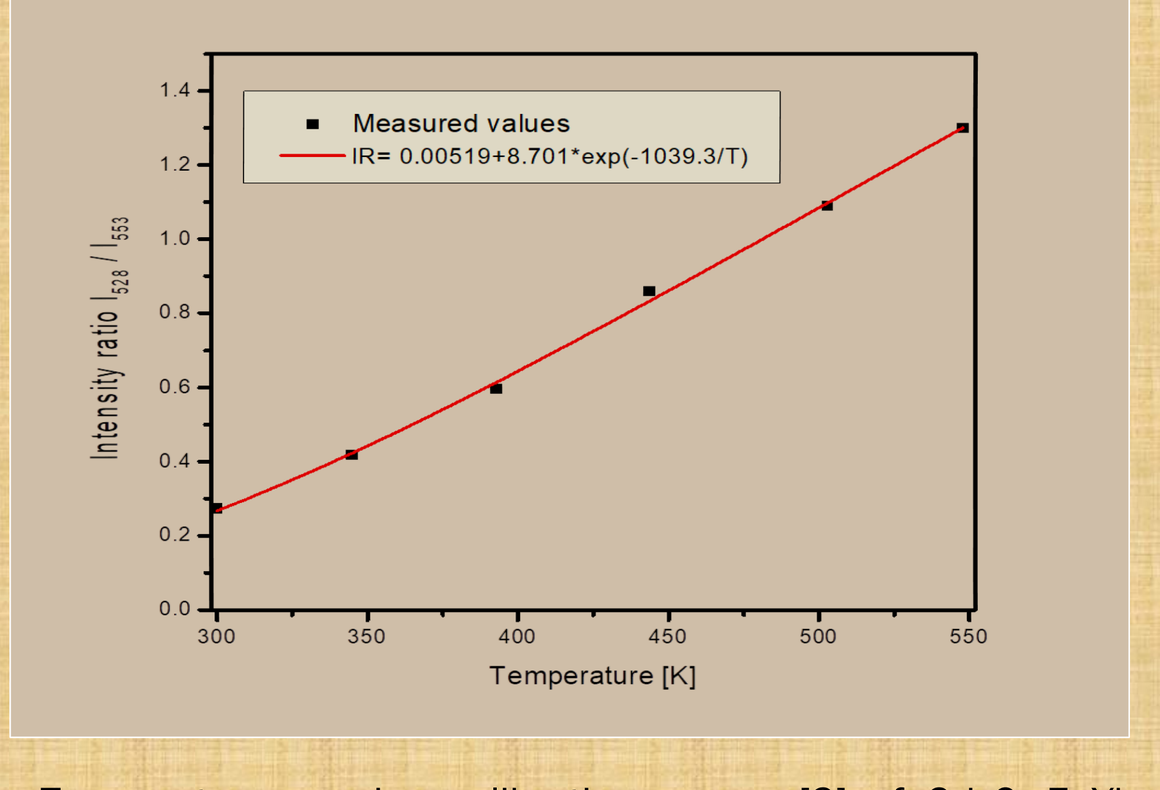
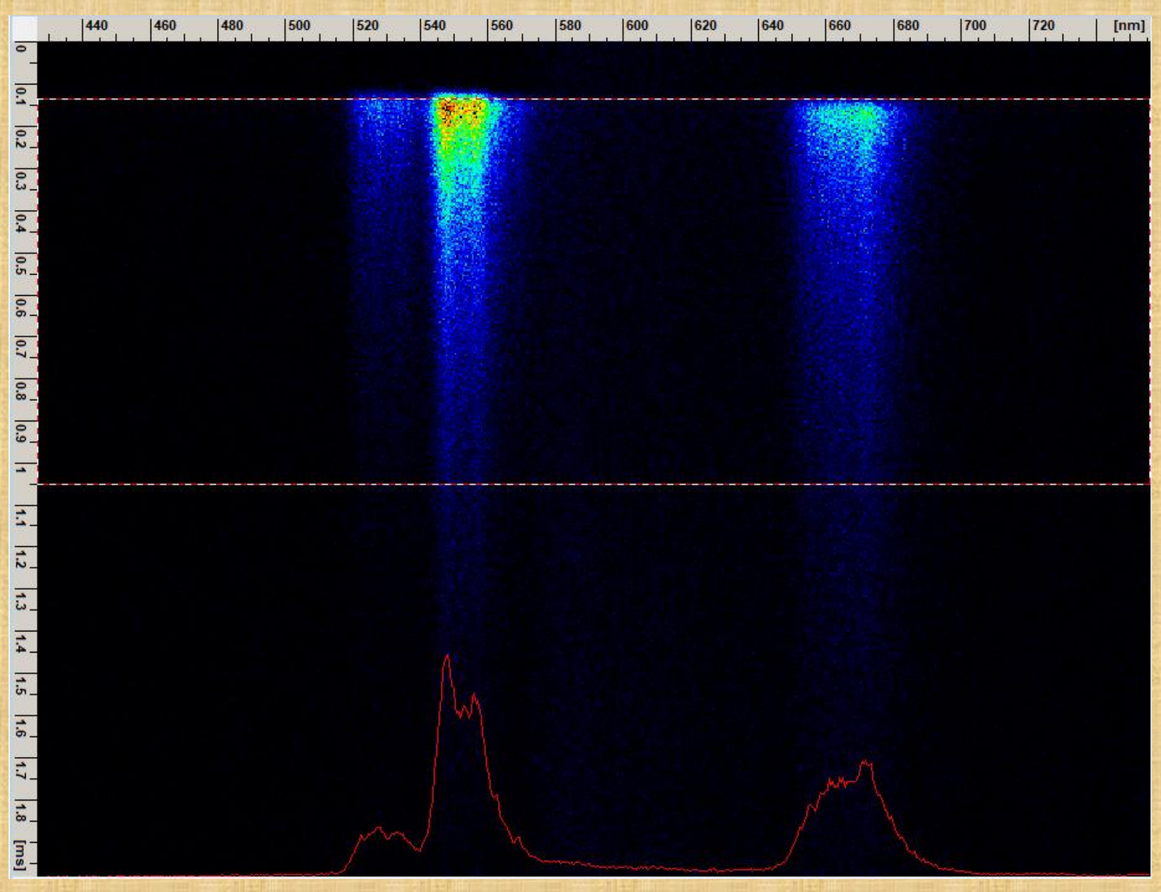
In this study we analyze effects of laser heating on luminescent properties of nanocrystalline Gd_2O_3 doped with Er^{3+} and Yb^{3+} cations. Material was synthesized by combustion method, as described in [1]. Our experimental setup is presented in detail in [2,3,4]. In this study we have used pulsed laser diode excitation at 980 nm. Variable laser pulse energy was obtained by varying the laser pulse duration. Used laser diode has both continual and pulse mode. In continual mode its power is 1 W; in pulse mode it is possible to tune pulse duration and repetition, thus obtaining different average excitation powers. Here, we have used repetition rate of 200 Hz, with varying pulse duration between 20 μs and 200 μs, so average excitation power is between 8 mW and 80 mW.

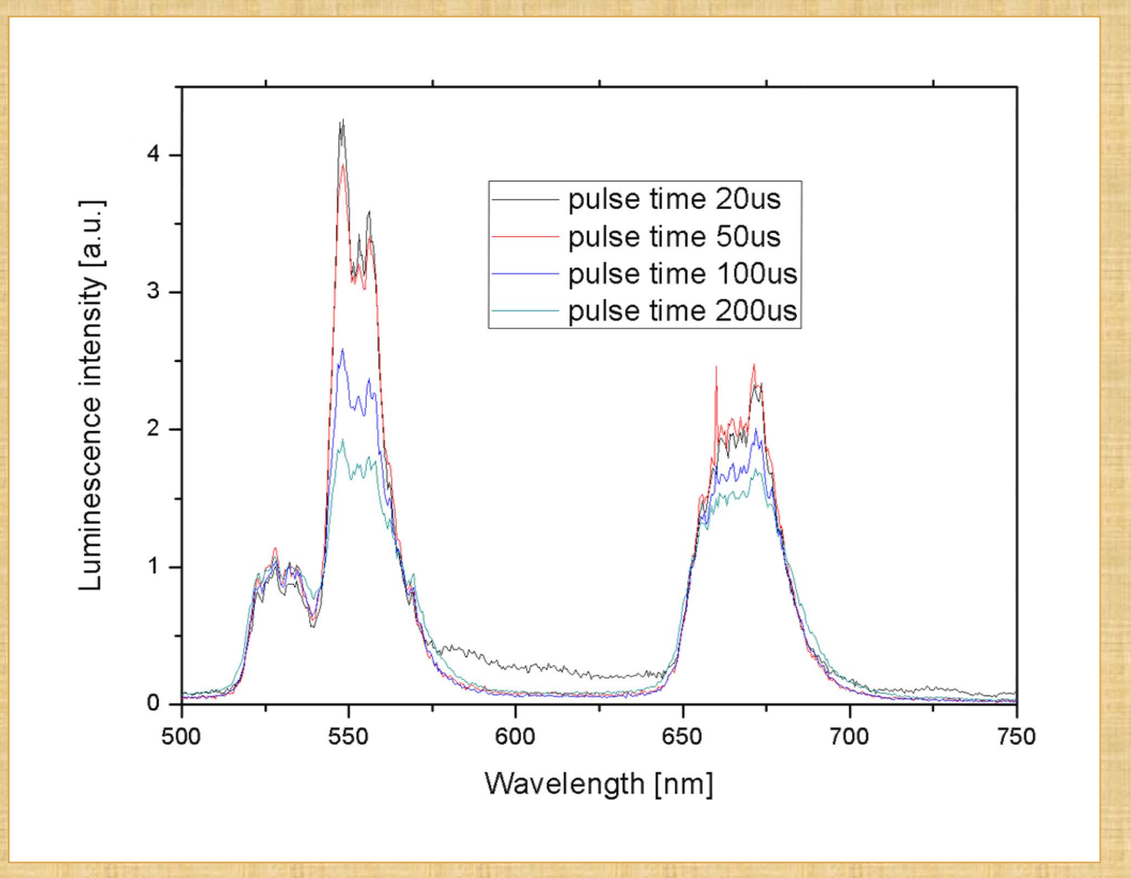
Generally, laser power heating effects are unwanted and should be avoided in luminescence thermometry experiments; external heater and thermometer are used to calibrate the temperature sensing curve. Interestingly enough, the thermometry system, based on laser heating of sample, applicable for biomedical purposes, is described in [5].



Temperature sensing calibration curve [3] of Gd_2O_3:Er,Yb, using intensity ratio of two Er emission lines, at 553 nm and 529 nm. Experimental points are denoted by black squares and fitted temperature calibration curve is denoted by red line.



Streak image of Gd_2O_3:Er^{3+},Yb^{3+} excited at 980 nm. Image is presented in pseudocolor where different colors correspond to different intensities. Vertical axis corresponds to time, here it is 2 ms from the start to the end of streak image. Horizontal axis corresponds to wavelengths of optical emisssion.



Luminescence spectra of Gd_2O_3:Er^{3+},Yb^{3+} excited at room temperature with different laser energies. It should be noted that excitation energy is intentionally much higher than used in [3]. Based on temperature sensing calibration curve presented in [3] for the same sample it could be estimated that the material is locally heated to about 375 K for pulse time of 200 μs.

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