Fluorescence imaging of nanostructured materials

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Application Note

Introduction

The main focus of our group is the investigation of the optical properties of individual metal- and semi-conductor nanostructures. Especially semi-conducting nanowires are promising materials for several applications such as sensors, solar cells and electronic components. For example the emission spectrum of cadmium sulfide nanowires with a diameter of ~60 nm and a mean length of 10 μm shows a sharp band at 500 nm and a broad band at 600 nm.[1] While the 500 nm emission is attributed to band gap transitions, the band around 600 nm is commonly related to surface traps. Hence the ratio of both bands can be used to investigate quality of the wires at different positions.

Experimental set-up

Our setup is a homebuilt confocal microscope using several lasers as excitation sources. The emission light can be detected either by an avalanche photodiode or the EMCCD detector iXon Ultra DU897 UCS-EXF. As spectrograph, we use the spectrograph Shamrock SR-300i-B with a triple grating turret with 300 l/mm and 150 l/mm gratings and a mirror. To get all the spectral information within a single scan of the sample, we take a spectrum of each raster point and afterwards reconstruct the image from the spectra. With this method we can create fluorescence- and Raman images based on several spectral lines.

Results

Figure 1 shows the reconstructed image of two single CdS nanowires and contains all spectral information in a scan range of 10 x 10 μm with a resolution of 100 x 100 pixels. The readout time of the EMCCD detector was 25 ms. Figure 2 shows four selected spectra of different locations on the wires as indicated in figure 1. Figure 3 and 4 present reconstructed images for different wavelength ranges, namely 493 – 523 nm and 528 - 669 nm, respectively. With this the spectral differences along the nanowires can clearly be visualized and in a next step analyzed in detail.

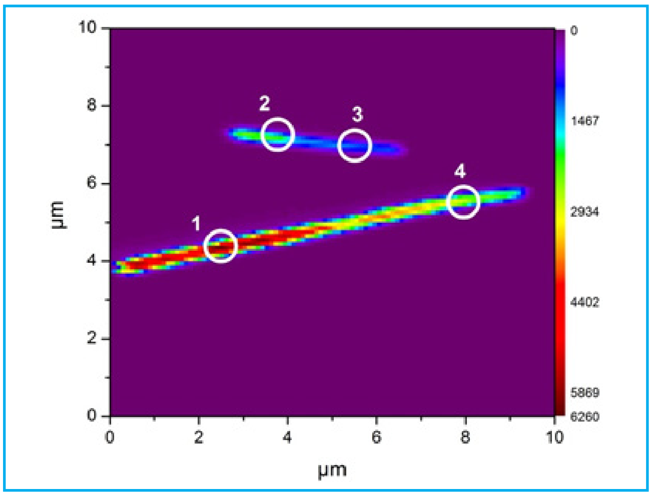

Fig. 1: Confocal scan of single CdS nanowires. The image was reconstructed from the complete spectrum.

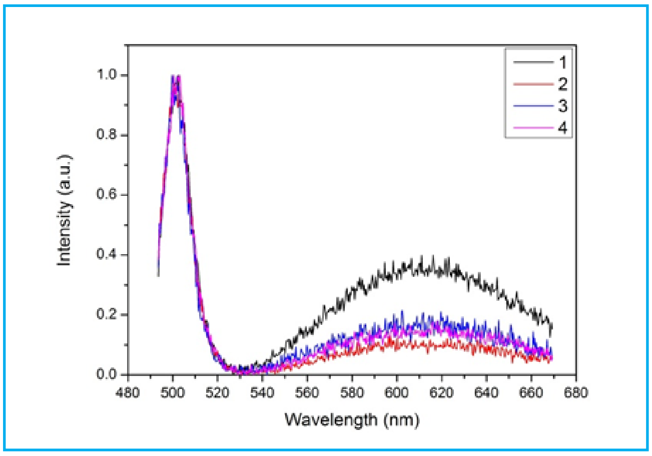

Fig. 2: Spectra from different positions on the CdS nanowires.

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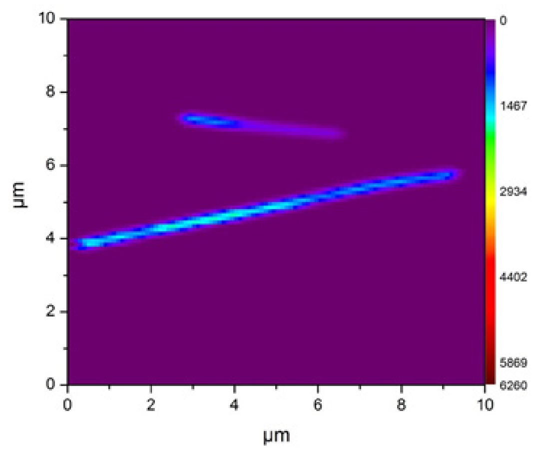

Fig. 3: Confocal scan of single CdS nanowires. The image was reconstructed with the wavelengths 493 nm - 523 nm.

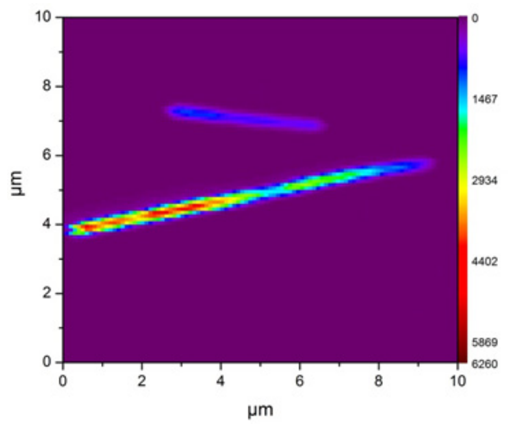

Fig. 4: Confocal scan of single CdS nanowires. The image was reconstructed with the wavelengths 528 nm - 669 nm.

Application Note

References

[1] T. Dufaux, J. Boettcher, M. Burghard, K. Kern, SMALL 6, 1868 (2010)

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