Preparation and Characterization of *CdSe* Colloidal Quantum Dots by Optical Spectroscopy and *2D DOSY NMR*

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Keywords: quantum dots, *CdSe*, nanocrystals, photoluminescence, *2D DOSY NMR*.

SUMMARY. We present experimental results on preparation and characterization of colloidal *CdSe* quantum dots (QD) in organic solvent. *CdSe* QDs were synthesized following a modified literature method and have been characterized by UV-Vis absorption and photoluminescent (PL) spectroscopy, as well as by *2D* Diffusion Ordered Spectroscopy (*DOSY*) *NMR*. The average *CdSe* particles size estimated from the UV-Vis absorption spectra was found to be in the range 2.28 - 2.92 nm, which correlates very well with the results obtained from *NMR* measurements. The PL spectrum for *CdSe* nanodots can be characterized by a narrow emission band with the peak maximum shifting from 508 to 566 nm in dependence of the *CdSe* nanoparticle size. The PL is dominated by a near-band-edge emission, accompanied by a weak broad band in the near IR, related to the surface shallow trap emission.

1. INTRODUCTION

Among various semiconductor quantum dots extensive research efforts have been developed over the last decade on *CdSe* QDs because of their attractivity for various application in optoelectronics, photonics, medicine, etc. [1-3]. In spite of the problems related to the toxicity of *Cd* compounds, the possibility of tuning of optical parameters of *CdSe* QDs makes them attractive for technological development for optoelectronics and biomedical applications. The size of QDs can be easily controlled by different ways, for example, by variation of the reaction time, or the temperature of the solvents, by variation of the concentration of the reaction solvents, etc. This means a relatively simply and convenient technology for controlling the optical parameters of the nanocompozite structures for practical exploitation. For example, PL emission from colloidal *CdSe* quantum dots can be adjusted in a relatively wide spectral range from 465 to 670 nm [2]. The technology makes it possible to prepare different sized nanocrystals with high PL efficiency and narrow emission band, while PL emission may cover a narrow spectral band, tuned from blue to red and even up to near infrared. Control and improvement of optical properties of *CdSe* quantum dots remain on the agenda of research in the field of nanotechnology.

2. EXPERIMENTAL DETAILS AND *2D DOSY NMR* MEASUREMENTS

The technology of preparation of the *CdSe* nanodots is well described in details in the literature and an extended list of publications in this field can be consulted [4-6]. Colloidal semiconductor QDs described in this paper were prepared via a chemical route.

2.1. Materials

Cadmium oxide (99.999%), oleic acid (90%), selenium (99.5%, 100 mesh), trioctylphosphine (*TOP*) (90%), 1-octadecene (*ODE*) (90%), tributylphosphine(*TBP*) (90%), were purchased from Aldrich and used without further purification.

2.2. Synthesis

CdSe semiconductor nanocrystals were synthesized in a three-neck flask equipped with condenser, magnetic stirrer, thermocouple, and heating mantle. Typically the synthesis of the nanocrystals *CdSe* was carried out at 170 ºC by the following method. At the first step the stock solution was prepared, containing 180 mg of Se powder, 3 ml of 1-octadecene, 2 ml tributulphosphine and 0.8 mL of trioctylphosphine are mixed with intense stirring. The *Cd*

Advanced Topics in Optoelectronics, Microelectronics, and Nanotechnologies VII,
edited by Ionica Cristea, Marian Vladescu, Razvan Tamas, Proc. of SPIE Vol. 9258,
92581W · © 2015 SPIE · CCC code: 0277-786X/15/$18 · doi: 10.1117/12.2070448