



TO

Matematicko-fyzikální fakulta UK
Studijní oddělení**Review of Michael Greben's doctoral thesis by supervisor
(posudek školitele disertační práce)**

The doctoral thesis by Michael V. Greben entitled *Advanced spectroscopic characterization of quantum dot ensembles* is an output of his four years of PhD studies under my supervision. The thesis is based on ten papers published in renowned international journals (with exception of one paper in proceedings and one review paper currently under revision) supplemented by a well-written introduction (about 80 pages long with 153 referenced papers). The thesis describes application of our special spectroscopic techniques - namely the measurements of absolute photo-luminescence (PL) quantum yields (QY), determination of absorption-cross section and measurements of slow PL kinetics. These techniques were developed mainly by me with assistance of Mr. Greben, who elaborated the theoretical background necessary to correctly design and interpret our experiments. The studied materials described in the thesis are various ensembles of semiconductor quantum dots (nanocrystals), mainly silicon and PbS, in liquid (colloidal suspensions) or solid form (deposited layers).

Michael V. Greben started to collaborate with me in 2012 with intention to perform PhD study in our department. Then, I arranged two his research visits in our Laboratory of Optical Spectroscopy at the Department of Chemical Physics and Optics and subsequently M. Greben applied for PhD study of "Physics of Nanostructures" in our faculty. He successfully passed the entrance examination and started in November 2013. During his previous MSc. studies in Belarusian State University in Minsk he has been working as laboratory assistant and junior researcher at the Department of Physical Electronics. He was participating on preparation and characterization of semiconductor nanocrystals produced by ion implantation.

In our laboratory he first performed experiments on external quantum yield of PbS and Si nanocrystals using the integrating sphere method. Later he concentrated on absorption-cross section calculations and systematical studies of slow PL kinetics in silicon nanocrystals and finally wrote an interesting review which resulted in the most complete and systematical treatment of this subject. The latest work (mostly unpublished yet) concerns determination of internal quantum yield via PL kinetics changes due to the Purcell effect in special wedge samples. The comparison of external and internal QY enables us to get unique insight into the distribution of dark nanocrystal population. This work (and several other subjects) is under preparation for publication.

During the four years of PhD studies Michael V. Greben build up a solid background knowledge in the field of semiconductor nanostructures and spectroscopy, as well as the art of scientific writing. He is strongly motivated researcher, who is able to recognize the interesting questions for research, find the adequate methods and perform independent scientific investigation. In my humble opinion Mr. Greben has very good perspective to become a successful scientist.

Let me note, that Michael Greben received two awards for his work and presentations in 2016: The Silver Price for Young Scientists from the Czechoslovak Spectroscopic Society and the Student Award at E-MRS Spring Meeting in Lille (Symposium O).

In conclusion, the thesis by M. V. Greben presents significant piece of work (10 papers) on advanced characterization of semiconductor nanocrystals which is very well presented. This work clearly demonstrates his ability to perform systematic scientific work within a broad international collaboration and achieve original results. According to my experience, this thesis largely exceed the average international level of PhD theses in our scientific field.

Therefore, I expressively recommend acceptance of the submitted dissertation as basis to award Michael V. Greben with the PhD title.

In Prague, March 1st, 2018

.....
Prof. RNDr. Jan Valenta, Ph.D.