

REVIEW OF THE HABILITATION THESIS

Name of the candidate: M.Sc. Rafael Omar Torres Mendieta, Ph.D.
Candidate's affiliation: Technická univerzita v Liberci: Liberec, CZ
Title of habilitation work: Laser-mediated manipulation of matter at the nanoscale
Field: AVI – Applied Sciences in Engineering
Reviewer: prof. RNDr. Jiří Sopoušek, CSc.
Reviewer's affiliation: Ústav chemie, Přírodovědecká fakulta Masarykovy university, Kamenice
753/5, 625 00 Brno

Introduction

The presented habilitation thesis summarizes the candidate's scientific research work. The submitted thesis involves the results of using pulsed laser sources in the following areas: element rearrangement in nanocomposites, nanoalloy formation, junction of multiple elements into new nanostructures, fabrication of nanoparticles by laser irradiation and material ablation.

The text consists of four main chapters. Each chapter consists of an elaboration followed by selected articles of the author. The thesis (including articles) has 190 pages. The final chapters are followed by a list of 138 references.

The work contains published results and ideas for consequent research in the field of nanoparticles and nanostructured materials of various types based on silver (Ag_2WO_4 , Ag_2CrO_4 , Ag/TiO_x), bismuth (Bi_2O_3), copper (Fe-Cu oxide nanocrystals, Cu oxides), iron (Fe NPs), indium (InP), carbon (carbon quantum dots), and also touches polymer nanofibrous membranes (PVDF).

The results of the research are obtained mainly by experimental methods using femtosecond laser irradiation, laser ablation, laser-assisted synthesis, and electron beam-induced matter formation.

The practical goals of the candidate's work are focusing for example on semiconductors, membranes for oil and water separation, and antifungal/antitumor agents.

In total, the thesis contains 17 peer-reviewed articles in high-impact professional journals. The thesis contains articles that the applicant considers to be the most beneficial for the current state of knowledge in the given field.

The elaborate and attached peer-reviewed articles are written in English. The reviewer found no errors or mistypes. The division into chapters is logical. The text of the elaboration effectively prepares the reader to understand the outputs involved in the attached professional articles of the candidate.

a) Actuality of the chosen topic

Nanostructures created by the local action of high energy are interesting objects often exhibiting special properties. These properties are significantly different from those of compact materials (bulk) with the same chemical composition. The use of laser beams as high-energy tools in materials science is current and promising for the future.

b) Used experimental and theoretical methods

The candidate uses the latest instrumental and experimental methods in his scientific work. His assessment of the obtained results is based on the latest scientific findings, theoretical approaches and models. He actively cooperates with the world's leading workplaces related to the subject area of research.

c) Evaluation of scientific research activity

- According to the globally recognized Web of Science citation database, the candidate (ORCID ID 0000-0002-9865-1826) has 35 records (24 articles, 527 Times Cited Without self-citations). The most cited article (DOI 10.1021/acsomega.7b0208271, published in 2018) is cited 71 times.

- The applicant is rated with an h-index of 14. This professional evaluation of scientific research meets the generally recognised requirements for obtaining the title of associate professor in the named field.
- The applicant was a member of the project teams. In 2020-2024, Czech member of Committee COST (project CA19123), 2x national projects of TUL, 5x national project MSMT, 1x EU project HORIZONT).
- The applicant completed a total of approx. 1/2 years of stay at a leading foreign workplace (Federal University of São Carlos, Brazil).
- The candidate was a guest editor for two special issues of the "Journal of Membranes"(MDPI publishing).
- He was an evaluator of grant proposals in open calls of the National Science Centre panel ST8, Poland, in 2019.

d) Benefit for the further development of science and technology

The candidate's scientific work brings new knowledge about the possibilities of using lasers to prepare, modify and characterise nanostructured materials and nanoparticles. Significant results published by the candidate cover the following areas

- the synthesis of fluorescent carbon quantum dots by laser fragmentation, production of electrospun nanofibers based on graphene oxide, in situ decoration of graphene sheets with gold nanoparticles, synthesis of solar nanofluid by pulsed laser ablation, fabrication of carbon quantum dots by laser irradiation in a continuous flow, laser-synthesized nanoparticles for catalytic pollutant degradation, formation of nanoparticles with antibacterial properties by femtosecond laser irradiation.

e) Comment

The title of the habilitation is not appropriate. The name evokes the idea that nanoparticles can be moved under control from one place to another by laser action. However, this is inconsistent with the candidate's publication activity as well as with current scientific knowledge. This is confirmed by the candidate's articles, which involve phrases: Laser-assisted synthesis..., Laser-Induced Formation of ..., Laser/Electron Irradiation on..., ... Laser-Mediated Heterojunction, Laser-synthesized Ag/TiO nanoparticles..., Fabrication by Laser Irradiation in a Continuous Flow Jet of..., Laser-induced fragmentation of ..., ... membranes modified via laser-synthesized Ag ..., etc.

Conclusion

The candidate has demonstrated his scientific qualifications through his professional results published in peer-reviewed journals. The scope of the applicant's pedagogical activity in teaching and guiding students corresponds to the commitment of academic staff at Czech universities.

The submitted habilitation thesis meets the requirements for the applicant's habilitation.

I recommend the commission to grant the candidate a Czech academic title: "docent" (associate professor).