Skoltech
Skolkovo Institute of Science and Technology

Jury Member Report – Doctor of Philosophy thesis.

Name of Candidate: Julijana Cvjetinovic

PhD Program: doctoral program in physic

Title of Thesis:
Optical and mechanical properties of diatom algae and related materials

Supervisor: Professor Dmitry Gorin

Name of the Reviewer: Yuri Kotelevtsev

I confirm the absence of any conflict of interest (Alternatively, Reviewer can formulate a possible conflict)	**Date: 19-09-2023**

The purpose of this report is to obtain an independent review from the members of PhD defense Jury before the thesis defense. The members of PhD defense Jury are asked to submit signed copy of the report at least 30 days prior the thesis defense. The Reviewers are asked to bring a copy of the completed report to the thesis defense and to discuss the contents of each report with each other before the thesis defense.

If the reviewers have any queries about the thesis which they wish to raise in advance, please contact the Chair of the Jury.

Reviewer's Report

Reviewers report should contain the following items:

- Brief evaluation of the thesis quality and overall structure of the dissertation.

The dissertation is well written in canonical way. It contains 281 pages, 101 Figures of which 66 expanded figures present major experimental results of the study. The literature review is well written and sets the state of the art diatoma biology together with the optical and mechanical methods applied to the structural studies of the diatoma shell. The experimental work robustly utilizes scanning and transmission electron microscopy, confocal microscopy, AFM to the structure evaluation of the diatoma.

- The relevance of the topic of dissertation work to its actual content

Dissertation is devoted to evaluation of novel optical methods to monitor diatom colonies in vitro and in the natural environment using the combination of optical and mechanical approaches. It also describes novel techniques to alter silica surface of diatoms suitable for the development of new nano materials and nano devices.

- The scientific significance of the results obtained and their compliance with the international level and current state of the art

The thesis contains experimental methods allowing measurement of propagation and the state of development of diatom alga in suspension and in colonies based on optical and optoacustic principles. Using AFM laser-induced resonance excitation The diatom resonant frequencies in the range 1-8 MHz have been
experimentally validated for the first time . New excitable nanomaterial with 6×10^3 enhanced Raman signal from Rhodamine 6G based on gold nanoparticle was generated. It was achieved by surface modification with gold
nanoparticles, using a combination of layer-by-layer assembly and
freeze-induced loading methods.

- The relevance of the obtained results to applications (if applicable)
  Deascibed methods are relevant to diatom monitoring in the environment. It also provides methods for construction of nano materials with photo excitable properties.
- The quality of publications
  Publications numbering 8 full papers are of the highest quality with the top journal in the list Science Advances, with impact factor 9, 5, and 4.The author the first and corresponding author in 5 papers.

- The summary of issues to be addressed before/during the thesis defense

The thesis provides ample data for analysis of the structure function relationship of the diatoma shell and underling biological processes which underpin the formation of this highly regular structure. Namely, how the organization of cytoskeleton and embodiment of Si pumps result in formation of the rigid structure with fixed spatial parameters. This may lay the prolongation of the invstigation in discussion. It will be great of the defendant can shape out possible future experiments in this direction.

Provisional Recommendation

X☐ *I recommend that the candidate should defend the thesis by means of a formal thesis defense*

☐ *I recommend that the candidate should defend the thesis by means of a formal thesis defense only after appropriate changes would be introduced in candidate's thesis according to the recommendations of the present report*

☐ *The thesis is not acceptable and I recommend that the candidate be exempt from the formal thesis defense*