

Jury Member Report – Doctor of Philosophy thesis.

Name of Candidate: Julijana Cvjetinovic

PhD Program: Physics

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

Supervisor: Professor Dmitry Gorin

Co-supervisor: Professor Alexander Korsunsky

Name of the Reviewer:

<p>Prof Dusan Losic, The University of Adelaide School of Chemical Engineering North Engineering Building, N206 Adelaide, SA 5005, Australia Phone: + 61 8 8313 4648, Phone 0423 926 275, Email: dusan.losic@adelaide.edu.au</p> <p>Confirmed no conflict of interest</p>	<p>Date: 17-09-2023</p>
---	--------------------------------

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.

This thesis titled "OPTICAL AND MECHANICAL PROPERTIES OF DIATOM ALGAE AND RELATED MATERIALS" by PhD candidate J. Cvjetinovic, is presented on 281 pages organized in 9 Chapters including introduction (1), literature review (2), Experimental (3), five our research chapters (4-8) and concluding chapter 9. Publishing outcomes from this PhD study as indicated in the thesis are: **9 the first author journal papers, 10 (second/third author) contributing journal papers and 13 the first author conference presentation (all oral)**. Based on this publication record this is exceptional outcomes showing an outstanding productivity rarely seen from PhD students worldwide.

Very high quality of this thesis is not only based on high number of publication and broad studied topics, but more importantly on their valuable scientific contributions on specific problems to the field of diatom nanotechnology. Diatoms are recognized as living nanotechnology laboratories that could provide learnings to scientists and engineers on how to solve global most concerning problems (energy, food, clean water, climate. etc) making this field very exciting and evolving. This thesis exploring some critical aspects on monitoring growth of diatoms colonies and individual diatoms are very important contribution to this field as diatoms are most significant O₂ producer and CO₂ adsorber and could lead towards developing potential strategy to address climate problems in natural way. Study on mechanical and optical properties provides valuable contribution to previous studies in this field confirming again outstanding properties of diatom structures. To use gold coated diatoms SERS substrate is demonstrated by several previous groups and here approach using gold nanoparticles on diatoms from diatomaceous earth is presented which is interesting approach showing another potential application of diatoms to be considered.

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

The scope of dissertation on exploring several topics such as monitoring, the optical and mechanical properties of diatoms their surface modifications are well aligned and relevant to its actual content presented in the thesis

The relevance of the methods used in the dissertation

The candidate in thesis used +20 different techniques across different disciplines from biology (cell culturing), in-vivo cell spectroscopy (fluorescence, acoustic), microscopy and imaging (light, SEM) for structural characterization, nanomechanics (nanoindentation), spectroscopy of single diatoms (UV, fluorescence), sensing (SERS) etc. This spectrum of experimental methodologies is unprecedented for one PhD usually focused on one and few methods showing very high caliber and the quality of PhD candidate. These methods are very relevant to this field and needs a lot of time to be established.

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

The most of research from this thesis is peer reviewed published in respected journal indicating this work has proven scientific contribution to the scientific community in the field of diatom nanotechnology. Several state-of-the-art approaches (monitoring, optical properties) are nicely demonstrated in this thesis with a strong confidence they will be followed and further advanced by other scientists. This assessor who worked actively in this field for many years can state that this contribution from the candidate and her supervisory team can be described as very significant and one of the most active group worldwide and deserve congratulation.

The relevance of the obtained results to applications (if applicable)

The obtained results from this thesis have potential to be translated even if this point is not strongly articulated. The most significant application is for monitoring growth of diatoms that can be applied in-vivo for their artificial growth as potential CO₂ adsorbents.

The quality of publications

The candidate published 9 the first author journal papers, 10 (second/third author) contributing journal papers and 13 the first author conference presentation (all oral).

The first author journal papers are mostly published in highly ranked peer -reviewed journals (most Tier 1) in discipline of Physics, Materials and Multidisciplinary such as Physical Chemistry Chemical Physics,

Journal of Physics, Photoacoustics, Scientific Reports etc indicating very high quality of PhD research work. Conference presentations were presented mostly at International conferences with high standing and the candidate presented her work orally.

Conclusion:

I would like to congratulate to Miss PhD candidate J. Cvjetinovic and her supervisor Prof. Dmitry Gorin and prof. Co-advisor Professor Alexander Korsunsky on successful completion of this research project and successful completion of PhD study. I recommend this thesis should be accepted for defence process and awarded the PhD degree. I would strongly recommend to be nominated for the awards for Excellence in PhD.

There are several comments and suggestions that the candidate may consider to improve the final version of this thesis after defense (if this process is applicable).

1. **The title:** It is suggested to consider removing the word “related materials” covering fossilized diatom which is really not related material. The title “Study of optical and mechanical properties of diatoms structures” would be more appropriate.
2. **Abstracts:** Abstract is too generic, and it needs improvement to provide more information about the project aims and objectives with more details about key findings and outcomes from thesis indicating their novelty and significance.
3. **Introduction Chapter 1:** It is suggested on the end of the introduction to include summary what is presented in each chapter (bullet points)
4. **Literature review Chapter 2:** It is suggested to present here what are key research gaps in diatoms field which are used to identify aims and objectives of this thesis which should be also included followed by brief methodology and experimental plan.
5. **Experimental Chapter 3:** It is noticed that in this section is missing information about culture media used to grow diatoms which is very important.
6. **Research chapters 4-8:** These research chapters on monitoring diatom colonies and visualization of living and cleaned individual diatoms, study their mechanical and optical properties of diatoms and modification of diatomite are presented as the collection of 5 different experiments on diatoms which are presented with unusual presentation style as research reports and not as scientific papers. The scientific value of the presented work could be increased significantly (if allowed) by improving the presentation style with better links and flow between chapters presenting this thesis to the readers as a nice story. A few suggestions for improvements to be considered. For each research chapter were applied on separate page provide info about related generated publications (papers and conferences) from this chapter with full title and the statement about contribution from the candidate that is missing. Each chapter is expected to have an abstract section to guide readers about the topic. Introduction or background section in addition to brief literature review should include research problem statement and aims and objectives, significance of the presented research that is missing but critical to show. Regarding other sections if the journal paper style is considered to have experimental and results/discussion section is the most common way as this structure is easy for the readers to follow. Conclusion sections also need improvement to be more focus not what is done rather showing what is achieved, with details of results, their significance and contribution of presented results the diatom field.
7. **Chapter 9 Conclusions:** For each conclusion points highlight where appropriate novelty and significance aspects. It is suggested to include future work and direction that is generated from this thesis.

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