Skoltech
Skolkovo Institute of Science and Technology

Jury Member Report – Doctor of Philosophy thesis.

Name of Candidate: Igor Salimon

PhD Program: Physics

Title of Thesis: Laser synthesis and modification of nanomaterials

Supervisor: Assistant Professor Sakellaris Mailis

Name of the Reviewer: Toby Hallam

I confirm the absence of any conflict of interest YES (Alternatively, Reviewer can formulate a possible conflict)	**Date: 29-09-2023**

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 relevance of the topic of dissertation work to its actual content
- The relevance of the methods used in the dissertation
- The scientific significance of the results obtained and their compliance with the international level and current state of the art
- The relevance of the obtained results to applications (if applicable)
- The quality of publications

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

The candidate has provided a thesis document that catalogues his work on laser modification of a variety of materials including GaAs, Porous silicon, and an aluminum alloy. The work also covers the laser synthesis of MoS_2 and WS_2 from a precursor thin film. A recurring theme of the work has been the introduction of periodic structures into the laser written regions corresponding to the phenomena called Laser-Induced Periodic Surface Structures (LIPSS).

Overall, it is representative of a significant body of work carried out by the candidate and his coworker's demonstrating expertise in a variety of nanofabrication and analysis tools. Several of the results chapters are related to work that is published in internationally relevant journals. Of these papers, the candidate is first author of three, indicating good engagement with the scientific community during the thesis work.

While the aspects mentioned above all point to a satisfactory doctoral PhD program, the clarity present in the publications was not clear in the thesis. The organization of the chapters, exposition of supporting literature, experimental logic, and detail provided in discussion require work.

I expect that the viva will be most suitable time to explore the discussion and analysis in detail. But, I would like to see the candidate address some key structural issues in the thesis before then:

Chapter structure:

The chapter structure does not clearly contextualize the work in the thesis. The introduction should be rewritten into four chapters:

1. An introduction that presents the motivation for work and a survey of the technological landscape that exists around the laser processing of materials.
2. A theory chapter that explains the foundational knowledge frameworks required to understand the thesis. This should include at least: Laser operation, and interactions between a laser emissions and materials including absorption, scattering, thermalization and ablation.
3. A literature review chapter that contains the state of the art for the work that will be reported upon later in the thesis. Subjects that should be included (but not an exhaustive list):
    a. The materials used: GaAs, AA2024, TMDCs, porous silicon. Particularly including the materials properties and a survey of applications relevant to the context of the thesis.
    b. The synthesis routes for the materials synthesized in the thesis MoS_2 WS_2 with particular focus upon the single precursor routes.
    c. Photodetectors with focus upon MoS_2 WS_2
    d. LIPSS
    e. A survey of laser induced modification of materials relevant to each of the different material systems from the thesis.
4. A methodology chapter outlining the techniques used in this work. Much of this chapter is already present in currently section 1.4, but, in particular, I would like to see a description and discussion of the laser writing tool that is used throughout the thesis and more detail in the section on Raman spectroscopy and Xray photoelectron spectroscopy (including details of analysis).

I note that some of the requested content is present in part in the existing chapter 1 and elsewhere throughout the thesis. The requested chapters should collect this content into the appropriate location in addition to writing new material.

Self-referencing

Throughout the thesis, the candidate has been very detailed in providing a short section at the beginning of each chapter to indicate what work was carried out by members of the team. Beyond this attribution self-referencing is not necessary and even distracting. Given that the candidate is presenting their work in its entirety they should develop arguments completely in their discussion instead of referring to the published work. I ask that the results chapters be revised to present the work without self-referencing. Published work by the candidate should be mentioned in the same section as the individual attributions.

Conclusions:

The current conclusion merely summarizes the results and briefly touches upon some outcomes. However, the conclusions and outlook are important to establish the impact of the thesis work upon the state of knowledge in the field. I ask that the candidate extend the final chapter to include a more detailed discussion of the impact of the findings presented in the results chapters including a discussion of possible future work.

Provisional Recommendation

☐ *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*