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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: Vasileios Apostolopoulos

I confirm the absence of any conflict of interest	**Date: 11-10-2023**

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 PhD thesis utilizes several characterization and surface modification technologies avenues that involve laser writing for some materials that are interesting in science and industry. The surface modification of bulk opaque materials is attempted and studied with ultraviolet UV oxidation of GaAs. Also, femtosecond ablation is used to form conical microstructures on aluminum alloys. There is work in thin films where laser synthesis of MoS_2 from precursor films with simultaneous periodic submicron patterning is achieved. The volume modification on transparent materials is achieved using lasers, specifically with UV lasers the densification of porous silicon is studied where it can be applied to integrated circuit writing. The thesis shows many new results in modification technologies using lasers but leaves a question on what are the most promising next steps in this research field.

Questions

1. What is the industry standard used at the moment to modify and structure GaAs? Are there processes where Laser writing is used to modify or structure GaAs in research or industry?
2. What exactly was the wafer used for the experiments, the thesis simply states ”The samples, which were used in our experiments, were sections of a GaAs (100) wafer with a thickness of 0.5 mm, but it would be useful to know if the GaAs is semi-insulating, undoped, doped and specify the method of growth and supplier.

   Also, I would like to know how do you think that different compositions would affect your findings?
3. In chapter 3 you write “The resulting nanoribbon arrays exhibit enhanced persistent photoconductivity, and their photocurrent increased by three orders of magnitude compared to their continuous film counterparts.” Could you state of what applications

could benefit from this, and maybe include some references with devices of TMDs that use photoconductivity.

4. More a comment rather than a question but a demonstration for an application for example by measuring reflectivity in an irradiated area would be I think useful.
5. What is the problem that you are trying to solve with the aluminum composite, I understand that the conical structures are poorly explained in literature but is there any other motivation. In figure 14 is the view from the top or a cross-section?
6. Could you give any information if there is literature working on waveguide writing in porous silicon. It fundamentally seems like a high loss material for waveguides so I would like to know what is the scope for producing integrated circuits.

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*