Skoltech

Skolkovo Institute of Science and Technology

Jury Member Report – Doctor of Philosophy thesis

Name of Candidate: Vsevolod Iakovlev

PhD Program: Physics

Title of Thesis: Advanced Synthesis of Single-Walled Carbon Nanotubes Films by Aerosol Method for Electro-Optical Application

Supervisors: **Prof. Albert Nasibulin, Skoltech, Russia**

Prof. Esko Kauppinen, Aalto, Finland

Chair of PhD defense Jury: Prof. Keith Stevenson, Skoltech ***Email:*** *K.Stevenson@skoltech.ru*

Date of Thesis Defense: October 4, 2019

Name of the Reviewer: Prof. Alexander Okotrub, Nikolaev Institute of Inorganic Chemistry SB RAS

I confirm the absence of any conflict of interest (Alternatively, Reviewer can formulate a possible conflict)	**Signature:** **Date: 12-08-2019**

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 the latest on August 13th. 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

Please write your statement / summary of issues to be addressed before the thesis defense here.

Single-walled carbon nanotubes is one of the most promising materials for various applications. The thesis entitled "Advanced Synthesis of Single-Walled Carbon Nanotubes Films by Aerosol Method for Electro-Optical Application" by Vsevolod Iakovlev considers the problem that have been inhibiting the progress for almost three decades – carbon nanotubes with tailored properties.

Under the guidance of prof. Albert Nasibulin and prof. Esko Kauppinen, Mr. Iakovlev performed a comprehensive research resulted in different novel methods. Vsevolod introduces a new reactor for the aerosol CVD growth of SWCNTs equipped with a spark discharge generator of catalyst nanoparticles. The systemtic study of the reactor resulted in a robust apparatus of high scalability. Moreover, having compared the spark discharge reactor for carbon nanotube production with the most abundant ferrocene-based counterpart, he outlines the role of the catalyst formation. For the first time the author used an artificial neural network algorithm to predict synthesis results and showed the post-treatment method for improvement of optoelectrical properties of films based on SWCNTs. Mr. Iakovlev illustrates the enhanced control over SWCNT synthesis via various electro-optical applications (saturable absorbers, bolometers, fiber Bragg gratings).

The thesis is well structured, the results mostly presented in a clear logical way. The methods employed as well as facilities used provide reliable results that validate the conclusions. The results highlighted within the thesis as well as the publications provided fit the highest level of scientific research within the field.

There are only minor imporvements that can be recommended. Those improvements mostly correscpond to structure/language and have no effect on scientific results provided:

1) Please check the captions and size of all the figures (e.g. figure 4.10);
2) Correct and update abbreviation list (e.g. FOM);
3) Please notice that not all references are in the correct style.
4) Provide a scheme describing the role of carbon nanotubes in fiber Bragg gratings
5) Provide supplementary information section within the publications (e.g. for machine learning the supplementary is extensive and important)

In conslusion, the contribution of Vsevolod Iakovlev to the field of nanomaterials is important and substantial. The dissertation is written in a good scientific language, quite accurately. Vsevolod Iakovlev carried out a significant amount of work and published seven peer-reviewed publications, in three of which he is the first author, and which are the basis for his dissertation. Mr. Vsevolod Iakovlev's thesis is an original work possessing both fundamental and application novelty. I recommend to publish the dissertation of Vsevolod Iakovlev after minor amendments and the candidate should defend the thesis by means of a formal thesis defense.

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*