Skoltech
Skolkovo Institute of Science and Technology

Jury Member Report – Doctor of Philosophy thesis.

Name of Candidate: Evgenia Gilshteyn

PhD Program: Materials Science and Engineering

Title of Thesis: Components for Stretchable Electronic based on Single-walled Carbon Nanotubes

Supervisor: Prof. Albert Nasibulin

Chair of PhD defense Jury: Prof. Nikolay Gippius, ***Email**: N.Gippius@skoltech.ru*

Date of Thesis Defense: 05 October 2018

Name of the Reviewer:

I confirm the absence of any conflict of interest (Alternatively, Reviewer can formulate a possible conflict)	**Signature:** **Date: 27-08-2018**

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 doctoral thesis of Evgenia Gilshteyn deals with stretchable and optically transparent conductive films based on random networks of single-wall carbon nanotubes (SWCNTs). The films were synthesized by chemical vapor deposition and simultaneous collection by filtering from the aerosol (dry deposition), which forms in the reactor, and then applied in various components and devices in the form of surface coatings.

The dissertation starts with a good summary of the background including an overview of the corresponding literature (**Introduction**), then continues with the **Materials and methods** having the details of experiments carried out (synthesis methods, assembly, characterization techniques and facilities, modeling). In the subsequent chapter **Results and discussion**, the results are summarized in a logical order, highlighting the major findings related to the electrical and structural properties of mechanically deformed CNT films on PDMS, hydrogel modification of CNTs, applications in supercapacitor as well as in combined piezogenerator and charge storage systems. At the end of thesis, the implications of the presented work are summarized in the chapter **Conclusions**.

The topics studied and discussed in the thesis are highly relevant, which is explained and justified well in the summary of the state-of-the-art in the **Introduction** by highlighting the major shortcomings of existing materials and technologies used today in the field for flexible and wearable electronics. As recognized by the candidate, well-designed architectures of CNT films on various flexible substrates can outperform existing technologies and may offer excellent alternatives to electrodes made of rigid metals or 3D nanocomposites. As also projected by the candidate, the results of the thesis will contribute to emerging technologies that aim to develop devices for wearable electronics and sensors in the future.

The presented study is very extensive and well-written. The methods used throughout in the work reflect the high quality and professionalism in both instrumentation and methodology granting the validity and accurateness of the results. The candidate clearly proves her capabilities in mastering a broad spectrum of experimental methods from synthesis (CNT films, transfer of those to substrates), through characterization (SEM, TEM, electrical measurements), to implementation and testing of devices (functionality testing in realistic working environment). The results are discussed in sufficient details and the conclusions drawn from those are adequate and sound.

While the overall manuscript is very convincing and mature, I suggest some minor corrections that shall be considered and/or carried out before the defense - if it is formally possible. (The comments are highlighted in the sticky notes of attached pdf file of dissertation.)

In summary, the results obtained and presented by Evgenia Gilshteyn are significant and of high quality by the means of any standards. The thesis is based on five scientific papers out of which four are published in international journals of high reputation and one in a conference proceeding (one additional manuscript is under preparation). It is worth pointing out here that in each paper, the candidate is the first author proving her contribution to the overall work was significant.

Accordingly, I am warmly recommending acceptance of Evgenia Gilshteyn's thesis for the formal 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*