

OPINION

on Thesis for obtaining the scientific degree "Doctor of Sciences"

in professional field 4.1 Physical sciences,

on defense procedure at the Faculty of Physics (FzF) of Sofia University "St. Kliment
Ohridski "(Sofia University)

The review is prepared by: Assoc. Prof. Viktoria Milkova Nakova, PhD,

Institute of Physical Chemistry, Bulgarian Academy of Sciences,

as a member of the scientific jury according to Order № ПД-38-148 / 15.03.2021 of the Rector
of Sofia University.

**Topic of the dissertation: " Energy Transport in Optically-created Densely-populated
Organic Triplet Ensembles "**

Author of the dissertation: Assoc. Prof. Stanislav Balouchev Balouchev, PhD

I. General description of the submitted materials

1. Data on the submitted documents

Under the present procedure, the candidate Assoc. Prof. Stanislav Balouchev has presented a Thesis and attached to it Abstract, original papers, as well as a table with a Reference for compliance with the minimum national requirements and the minimum requirements of Physics Department, according to the regulations for acquiring scientific degrees and holding academic positions at Sofia University "St. Kliment Ohridski". The candidate has also presented lists of publications and patents focused on the same topic, but not include in the thesis.

The documents submitted by the candidate fully comply with the requirements of the Law on the Protection of Scientific and Technological Research, the Rules of Procedure and the Regulations for the Acquisition of Scientific Degrees and Academic Positions at Sofia University "St. Kliment Ohridski".

2. Details of the candidate

Assoc. Prof. Dr. Stanislav Balouchev has obtained a master's degree in Laser Physics at the Faculty of Physics of Sofia University "St. Kl. Ohridski" in 1990. His scientific career began at the Department of Quantum Electronics at the Faculty of Physics at Sofia University, where a few years later he obtained PhD. In 2009 Assoc. Prof. Balouchev obtained an academic degree in the Department of Optics and Spectroscopy. His research work at the Faculty of Physics at Sofia University was interrupted by several very successful specializations in Germany, Austria and Israel.

3. General characteristics of the candidate's scientific achievements

According to the information provided, Assoc. Prof. Dr. Balouchev has remarkable scientific achievements, as evidenced by the number of his publications in international journals with a high impact factor, the impressive number of approved international patents and the number of citations in international journals (over 2400, *h*-index 25).

The presented Thesis combines the results obtained in 21 publications and 9 international patents, presented at 14 national and international scientific forums.

The scientific publications included in the Thesis fully meet the minimum national requirements and respectively the additional requirements of Sofia University "St. Kliment Ohridski" for obtaining the scientific degree "Doctor of Physical Sciences". These publications do not repeat those of previous procedures for acquiring a scientific title and academic position, and no plagiarism has been noticed in the presented dissertation and abstract.

4. Analysis of the scientific and scientific-applied achievements of the candidate related to this application.

The presented Thesis combines research dedicated to energy transport in densely populated organic triplet ensembles and especially to the process of incoherent annihilation up-conversion. There are 12 chapters, which describe in detail the nature of the process and the possibilities for its application in polymer films, in the design of organic, flexible and transparent displays, solar cells, cultivation of photosynthetic bacteria, surfactant (micellar) solutions, nanostructured soft matter (polymer nanoparticles and capsules, nanofibers, cells).

I characterize the contributions of Assoc. Prof. Balouchev as 1) formulation of new theories and hypotheses, 2) development and application of new methods and materials, as well as 3) enrichment of existing knowledge.

The Thesis has a markedly interdisciplinary character. Although the research described in the dissertation is based on complex and strictly physical processes and phenomena, the correlation between them and the inclusion of innovative nanomaterials (nanoparticles, polymer capsules, organic fibers) using triplet-triplet annihilation up-conversion is remarkable. Therefore, in accordance with the highly interdisciplinary nature of the dissertation, the analysis of defined contributions requires specific competence in various aspects of these studies. The main *scientific contributions* are related to theoretical and experimental research addressed to the nature and overcoming of the existing limitations in the process of triplet-triplet annihilation up-conversion (TTA-UC).

The scientific-applied contributions are related to the possibilities for the application of TTA-UC in nanostructured soft matter (polymer nanoparticles and capsules, nanofibers, cells) and the development of a nanosensor that allows the study of temperature and oxygen content in cells.

All of the candidate's publications are co-authored, which is understandable given the current interdisciplinary nature of research, but I believe that the candidate's personal contribution to the results achieved is dominant.

5. Critical remarks and recommendations

The presented Thesis includes an impressive number of experimental results, but it is clearly written and precisely structured. I have no critical remarks and recommendations to the candidate and the submitted documents.

6. Personal impressions of the candidate

I do not know Assoc. Prof. Balouchev personally, but based on the presented materials I can confidently conclude that he is an active scientist, whose results and contributions are significant and not only fully meet the minimum national requirements, but significantly exceed them.

7. Conclusion

After getting acquainted with the presented Thesis, Abstract and other additional materials, and based on the analysis of their significance and contained in them scientific and scientific-applied contributions, I confirm that the scientific achievements meet the requirements of ZRASRB and the Regulations for the application and the relevant Regulations of Sofia University "St. Kl. Ohridski" for obtaining the scientific degree "Doctor of Physical Sciences". In particular, the candidate satisfies the minimum national requirements in the professional field and no plagiarism has been established in the dissertation, abstract and scientific papers submitted at the competition.

I give my positive assessment of the dissertation.

II. OVERALL CONCLUSION

Based on the above, I recommend the scientific jury to award the scientific degree "Doctor of Physical Sciences" in professional field 4.1 "Physical Sciences", Physics of Atoms and Molecules to Assoc. Prof. Stanislav Balouchev Balouchev, PhD.

28. 05. 2021

Reviewer:

Assoc. Prof. Viktoria Milkova Nakova, PhD