REVIEW

of dissertation work

for acquisition of scientific degree „Doctor of Physical Sciences“,

professional direction 4.1 “Physical Sciences”, for a defense procedure

in the Faculty of Physics, Sofia University “St. Kliment Ohridski” (SU)

The review is prepared by **prof. dr. Temenuzhka Atanasova Yovcheva – Plovdiv University “Paisii Hilendarski”** in her capacity of a scientific jury member according to Order No RD 38-464/27.07.2022 issued by the Rector of Sofia University.

Subject of the dissertation work: “Surface Photovoltage Spectroscopy of Semiconductor Optoelectronic Materials and Nanostructures”

Author of the dissertation work: Assoc. Prof. Dr. Veselin Todorov Donchev

I. General description of presented materials

1. Data on presented documents

The candidate assoc. prof. Dr. Veselin Todorov Donchev has presented a dissertation work and author’s abstract together with the obligatory tables for the Faculty of Physics in the Regulations on the terms and conditions for acquiring scientific degrees and occupying academic positions at SU "St. Kliment Ohridski". The necessary number of other documents supporting the achievements of the candidate is presented.

Documents presented by the candidate in the defense procedure (in electronic format) meet the requirements of the Act on Development of the Academic Staff in the Republic of Bulgaria, Rules for Implementation of the Law on the Development of the Academic Staff in the Republic of Bulgaria and the Regulations on the terms and conditions for acquiring scientific degrees and occupying academic positions at SU "St. Kliment Ohridski", including the increased requirements of the Faculty of Physics.

2. Candidate's Records

Assoc. Prof. Dr. Veselin Todorov Donchev was born on September 11, 1959 in Sofia, he is married and has two children. In 1985 he acquired a Master’s degree from the Faculty of Physics at SU “St. Kliment Ohrisdki”. In 1991 he defended a thesis on the subject: “Investigation of Electrical and Optical Properties of Point Defects in Gallium Arsenide” and acquired a Doctoral degree in Solid State Physics in the Faculty of Physics, SU “Kliment Ohridski”. He was appointed as a physicist in the Faculty of Physics at SU “Kliment Ohrisdki” in 1991. In the following years, he held different academic positions and in 2004 he was appointed as associated

professor in the department „Condensed Matter Physics and Microelectronics“ of the Faculty of Physics at SU “Kliment Ohridski”. In 2013 he was appointed as Head of the same department. As a university lecturer he delivers lectures in five different disciplines. He is the head of the students’ laboratory of electricity and magnetism. He was a scientific supervisor to six and consultant to four graduate students, as well as consultant to 2 doctoral students. He was a supervisor of one successfully graduated doctoral student and currently supervises one. He had height scientific visits to physics laboratories abroad.

3. General description of candidate‘s scientific achievements

Scientific results of the candidate presented in the dissertation work are in the field of the electronic and optical properties of semiconductor materials and structures (photoelectric and optical methods, computer simulations). Main directions in which the candidate worked and continues to work are surface photovoltage spectroscopy of a) materials for photovoltaics (Ga(In)As(Sb)N, Si, perovskites); б) semiconductor materials and nanostructures for optoelectronic applications (emitters, detectors); calculation of reflectance and transmission spectra of multilayer structures with consideration of interface roughness.

Fifteen scientific publications in impact factor journals are included in the dissertation work. Six conference papers published in impact rank journals are presented, together with three scientific publications in other journals.

Scientific publications included in the dissertation work meet and exceed the minimum national requirements (art. 2b, par. 2 and 3 of the Act on Development of the Academic Staff in the Republic of Bulgaria) and respectively the additional requirements of the Faculty of Physics, SU “Kliment Ohriski” for acquiring scientific degree “Doctor of Physical Sciences” in the respective scientific area and professional direction.

Scientific publications included in the dissertation work are unique and do not copy ones from previous procedures for the acquisition of a scientific degree and academic position.

There is no proven plagiarism in the submitted dissertation work and abstract.

4. Content-related analysis of the scientific and applied achievements of the candidate presented in the materials for participation in the competition.

Scientific achievements presented in the dissertation work are in three directions:

- design, construction and improvement of an experimental installation for SPS;
- development of new approaches for extracting information from SPV spectra;
- application of the developed equipment and methodology for the study of various materials and nanostructures for optoelectronics and photovoltaics.

An extremely important achievement of the applied research and great merit of the candidate is the development of an experimental setup and procedure for measuring SPS in MIS

operation mode allowing SPV measurements in wide spectral and temperature ranges. It should be noted that part of the research and analyses are conducted for the first time:

- the zero value of the SPV phase is defined and two new approaches to extract information from the SPV phase spectra of semiconductor bulk materials and nanostructures are developed;
- the first SPS research of three types of multilayer structures with quantum dots is conducted.

The applied character is also confirmed by multiple original research:

- of optical properties and electronic structure of AlAs/GaAs superlattice with GaAs embedded quantum wells with non-sharp interfaces;
- of Si nanowires prepared by metal-assisted chemical etching, which are promising for reducing the reflection in Si solar cells;
- SPS and photoluminescence studies of GaAs-based dilute nitride layers and structures grown by liquid epitaxy.

In applied aspects the obtained results are of interest for the creation of new optoelectronic, photonic and photovoltaic discrete components and integrated circuits.

From a fundamental point of view, the research presented in the dissertation contributes to the systematic and in-depth study of the optical and electronic properties of modern semiconductor optoelectronic materials and nanostructures.

Assoc. prof. dr. Veselin Todorov Donchev is the first author in 13 of the 24 scientific publications included in the dissertation work and the second one in 10 of them. According to Scopus his h-factor is 9. This undoubtedly reflects candidate's personal contribution and the high quality of the research.

5. Critical notes and recommendations

I do not have critical notes on the dissertation and the author's abstract. I recommend the candidate to continue his work in the same direction with an applied nature, using the accumulated knowledge and skills to create a utility model or patent for new discrete components or integrated circuits.

6. Personal impressions of the candidate

I know assoc. prof. Dr. Veselin Todorov Donchev from our participation in different conferences on physics. He was a lecturer in master's program "Condensed Matter Physics" at Plovdiv University. My impression is that Prof. Veselin Donchev is a well-established physicist with diverse interests and competencies in the field of condensed matter physics. He has the necessary potential to formulate and solve scientific problems concerning any field of physics, with a focus on the electronic and optical properties of semiconductor materials and structures. I

congratulate him for his persistence and perseverance in his professional growth. I believe that the presented dissertation work is only a step in the successful career of Prof. Donchev.

7. Conclusion

After considering the presented dissertation work, author's abstract and other materials and based on the analysis of their significance and the scientific applied contributions contained in them, **I confirm** that the scientific achievements meet the requirements of the Act on the Development of the Academic Staff in Republic of Bulgaria and the Regulations for its application and the respective Regulations of SU "St. Kliment Ohridski" **for the acquisition of the scientific degree "Doctor of Physical Sciences", as well as the increased requirements of the Faculty of Physics.** In particular, the candidate meets the minimum national requirements in the professional field and no plagiarism has been found in the dissertation work, author's abstract and scientific works submitted for the competition.

I give my positive assessment of the dissertation work.

II. GENERAL CONCLUSION

Based on the above, **I recommend** the scientific jury to award the **scientific degree "Doctor of Physical Sciences"** in professional direction 4.1 "Physical Sciences" to Assoc. Prof. Dr. Veselin Todorov Donchev.

18.09.2022 г. Prepared by: .....

(Prof. Dr. Temenuzhka Yovcheva)