STATEMENT REVIEW

by Aneliya Mincheva Dakova-Mollova, PhD

Associate Professor at the Department of Physics, Faculty of Physics and Technology,

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regarding a dissertation for the award of the educational and scientific degree **"Doctor" (PhD)**

in: Higher education area 4. Natural Sciences, Mathematics and Informatics,

Professional field 4.1. Physical Sciences,

Doctoral program "Electrical, Magnetic and Optical Properties of Condensed Matter"

Author: Aleksandar Vasilev Grigorov

Topic: Modified multilayer structures for immobilization of bioactive molecules

Supervisor: Assoc. Prof. Asya Petrova Viraneva, PhD

1. General presentation of the procedure and the PhD student

By order No. RD-22-2563 dated 16.12.2025 of the Rector of Plovdiv University "Paisii Hilendarski", I have been appointed as a member of the Scientific Jury for the dissertation defense procedure on the topic " Modified multilayer structures for immobilization of bioactive molecules" for the acquisition of the educational and scientific degree "Doctor" (PhD) in the higher education area 4. Natural Sciences, Mathematics and Informatics, professional field 4.1. Physical Sciences, doctoral program "Electrical, Magnetic and Optical Properties of Condensed Matter".

The author of the dissertation is Aleksandar Vasilev Grigorov – a full-time PhD student at the Department of Physics, supervised by Assoc. Prof. Asya Viraneva, PhD.

The set of hard-copy materials submitted by the PhD student includes the following documents: an application to the Rector of PU for initiating the defense procedure; CV in European format; minutes of the preliminary discussion at the department and an opinion from the supervisor regarding the readiness for the preliminary discussion; the PhD thesis; an abstract in Bulgarian and English; a declaration of originality and authenticity of the attached documents; a statement of compliance with the minimum national requirements; a list of scientific publications on the dissertation topic and 4 copies of the articles.

All submitted documents have been prepared in accordance with Art. 36 (1) of the Regulations for the Development of the Academic Staff of Plovdiv University "Paisii Hilendarski" and the Development of Academic Staff in the Republic of Bulgaria Act (DASRBA).

Aleksandar Grigorov completed his Bachelor’s degree in 2015 at the University of Aberdeen in Scotland, majoring in Physics. In 2018, he completed his Master’s degree in "Condensed Matter Physics" at Plovdiv University "Paisii Hilendarski". In 2019, Aleksandar Grigorov began his full-

time doctoral studies at the Faculty of Physics and Technology of PU. Since 2021, he has been an Assistant Professor at the Department of Physics.

I know Aleksandar personally and I have very good impressions of him as a young scientist and lecturer.

2. Relevance of the topic

Modern systems for the controlled release of various types of drugs enable the targeted delivery of the required biologically active substance to the treated areas. This not only reduces the total amount of medication needed but also overcomes several factors that diminish its effectiveness. Currently, there is a wide variety of materials that could find application in these systems. Biodegradable polymers are of particular interest due to the fact that their degradation does not release toxic products. This serves as the basis for creating fully biodegradable alternatives to more widely used medical products. For this reason, the topic of the PhD thesis proves to be highly relevant and especially pertinent to the field of modern medicine.

3. Knowledge of the problem

The PhD student Aleksandar Grigorov has conducted a thorough analysis of the existing scientific literature. A total of 220 literary sources are cited, one of which is in Bulgarian, while all others are in English. The majority of these are articles in journals indexed in the Scopus and Web of Science databases. The cited sources span publications from 1937 to 2025, which implies a profound analysis of the subject matter under consideration. From the list of cited literature, it can be concluded that the PhD student has gained deep insight into the current state and development trends of the problems addressed in the dissertation.

4. Research methodology

The presented dissertation provides a detailed description of the materials used, as well as the primary methods for obtaining various types of multilayer biodegradable films. It covers the techniques for their modification and characterization, methods for determining the activity of the immobilized enzyme within the multilayer films, and the models used to describe the drug release process from the resulting films. The PhD student has presented the experimental results categorized into three main groups based on the modification method of the polymer films: non-porous, porous lyophilized, and porous composite polymer films containing polyethylene glycol. The study investigates the impact of various modifications of polylactic acid and polyepsilon-caprolactone films on the immobilization and release of four types of biologically active substances from polyelectrolyte layers of chitosan and casein or xanthan, applied to the film surface. Furthermore, the influence of pH and ionic strength of the polyelectrolyte solutions on the release rate and the amount of immobilized substance has been examined. Six scientific and research contributions are specified, highlighting the applied scientific value of the dissertation.

5. Characterization and evaluation of the dissertation and its contributions

The submitted dissertation consists of 165 pages and includes 65 figures, 12 tables, 7 formulas, and 220 cited literary sources. The content is divided into nine chapters, structured into an introduction justifying the relevance of the work; a literature review presenting the main deposition methods for various materials to create multilayer structures capable of incorporating biologically active substances; aims and objectives; materials and methods; results and discussion; conclusions; contributions; bibliography and appendices, which include lists of the PhD student's publications, project participations, and conference presentations.

For the first time in this dissertation, the influence of the electric field, surface modifications, and the porous structure of biodegradable polymer substrates on the immobilization and release kinetics of biologically active substances has been investigated.

The PhD student has participated in 4 international scientific conferences and has been a member of the research teams of 5 scientific projects.

6. Assessment of publications and the personal contribution of the PhD student

The PhD student Aleksandar Grigorov has presented 4 publications related to the topic of the dissertation.

A discrepancy was found in the scoring of two of the articles published in the journal Coatings by MDPI. The dissertation and the abstract state that these have a Q1 quartile for 2024 and 2025, carrying 25 points each. After a check in Scimago and Journal Citation Reports, it appears that for the specified years, the journal is ranked in Q2, therefore carrying 20 points per article. The other two articles presented in the dissertation are in the journals Journal of Chemical Technology and Metallurgy and Bulgarian Chemical Communications, which have quartiles Q3 and Q4, respectively. These have been scored correctly. Based on the presented scientific publications and after the reduction of points, the PhD student has secured 67 points, exceeding the minimum requirement of 30. All submitted articles are co-authored, and he is the lead author in one of them.

The number and quality of the publications fully meet the minimum criteria and comply with the requirements of Plovdiv University "Paisii Hilendarski" and the Faculty of Physics and Technology for the acquisition of the educational and scientific degree "Doctor" (PhD).

7. Abstract

The abstract is presented in both Bulgarian and English. It consists of 32 pages, including contributions, participation in research projects, international conferences, and publications related to the PhD thesis. The abstract accurately reflects the content of the dissertation in a concise form. It has been prepared according to the requirements and is in full compliance with the dissertation.

8. Recommendations for future use of the dissertation contributions and results

Based on the results achieved in the dissertation, I would recommend that the PhD student continues his research in this scientific field by utilizing other dosage forms, as well as by mastering new methodologies for obtaining various polymer structures.

CONCLUSION

After a thorough examination of the PhD thesis and the publications of the doctoral student Aleksandar Vasilev Grigorov, I am convinced that the results achieved in the conducted research were obtained with his active participation. Through the presented dissertation, he demonstrates deep knowledge and skills for conducting research activities and solving scientific problems independently.

Aleksandar Grigorov's PhD thesis contains scientific and applied research results that represent an original contribution to the scientific community and fully comply with the requirements of the Development of Academic Staff in the Republic of Bulgaria Act, the Regulations for its implementation, and the Regulations for the Development of the Academic Staff of Plovdiv University "Paisii Hilendarski".

In light of the above, I give my **positive** assessment of the research presented in the reviewed dissertation, the abstract, the achieved results, and the contributions. I propose to the esteemed Scientific Jury **to award** the educational and scientific degree "Doctor" (PhD) to Aleksandar Vasilev Grigorov in the higher education area: 4. Natural Sciences, Mathematics and Informatics, professional field 4.1. Physical Sciences, doctoral program "Electrical, Magnetic and Optical Properties of Condensed Matter".

Date: 12.02.2026 **Reviewer**: .....

/Assoc. Prof. Aneliya Dakova-Mollova, PhD/