

STATEMENT

by prof. Ginka Atanasova Antova, PhD,

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on the dissertation for awarding the educational and scientific degree “Doctor of Philosophy” (PhD)

Area of higher education: 4. Natural sciences, mathematics and informatics

Professional field: 4.2. Chemistry sciences

Doctoral program: Physical Chemistry

Author: *Mariya Genova Pimpilova*

Thesis: “*Modification of glassy carbon electrodes with electrodeposited gold or 2D-nanomaterials: characterization and applications*“

Supervisor: *Assoc. Prof. Nina Dimitrova Dimcheva, PhD, University of Plovdiv „Paisii Hilendarski“*

1. General overview of the procedure and the PhD student

By order № RD-21-245/30.01.20224 of the Rector of Plovdiv University "Paisii Hilendarski" I was appointed a member of the scientific jury to provide a procedure for the defense of a dissertation on “Modification of glassy carbon electrodes with electrodeposited gold or 2D-nanomaterials: characterization and applications“ for obtaining the educational and scientific degree "Doctor" in the area of higher education 4. Natural sciences, mathematics and informatics, professional field 4.2. Chemical sciences and doctoral program “Physical chemistry”. The author of the dissertation is Mariya Genova Pimpilova - PhD student in full-time form at the Department of Physical chemistry with supervisor Assoc. Prof. Nina Dimcheva from University of Plovdiv "Paisii Hilendarski".

The set of materials on electronic media presented by doctoral student Mariya Pimpilova is in accordance with Article 36 (1) of the Regulations for Development of the Academic Staff of the University of Plovdiv and includes all the necessary documents.

The doctoral student has submitted a dissertation, abstract and 2 publications in scientific journals indexed in global databases (*Web of Science, Scopus*) and co-authorship in 1 patent application for invention.

Mariya Pimpilova has been enrolled as a doctoral student since 1.03.2019, and on 01.09.2022 she completed her studies with the right to defend a dissertation, as during this period she also worked as an assistant in the Department of "Physical chemistry" and in the Center for Technologies in the "Biosensors" section.

The dissertation consists of six main chapters, presented on 134 standard pages, including review, presentation of research, experimental part, results and discussion, conclusions, used references (238 literature sources), scientific and scientific-applied contributions and list of publications included in the dissertation and participation in scientific forums.

2. Relevance of the topic

In recent years, there has been a growing interest in the development of rapid methods for food quality control, environmental monitoring and the diagnosis of various diseases. The disserta-

tion presented by Maria Pimpilova examines the preparation of modified electrode surfaces and the development of highly sensitive electrochemical methods based on them for the determination of target analytes. The topic of the presented dissertation is current, as research has been conducted on the search for reliable, selective and sensitive methods for the determination of biologically significant compounds. The main significance is determined by the lack of similar kind of in-depth studies, as well as from revealing the significant potential of the developed electrochemical methods to be used as an alternative to the classic standard methods used in analyzes in various fields.

3. Knowledge of the problem

The review describes the methods and materials for modifying electrode surfaces, as well as the methods for their characterization, with attention being given to specific electroanalytical applications of modified electrodes. The described 238 literary sources, all are in Latin, show the good literary knowledge of the doctoral student. A significant part (over 73%) of them is after the year 2015, which is an indication of the use of modern scientific research on the topic of the dissertation. The conclusions drawn from the review allowed the doctoral student to correctly and clearly formulate the purpose and the tasks arising from it, which correspond to the topic of the dissertation.

4. Research methodology

The section materials and methods describe the used materials, equipment, methods for obtaining modified electrode materials, as well as the methods used in their characterization. The chosen methods for modifying electrodes, as well as the methods for their research, allow the achievement of the goal and the fulfillment of the set tasks. During the research work, the doctoral student mastered various methods of analysis, became familiar with modern analytical methods, which is why I consider that the educational task in the development of the dissertation has been fulfilled.

5. Characteristics and evaluation of the dissertation and contributions

The dissertation is very well formed and structured, as the individual chapters are presented in chronological order on 134 standard pages. In the first three chapters of the dissertation, 12 schemes are included, and in the results and discussion section, the own results are presented in 6 tables and illustrated in 44 very well-designed figures. The research was conducted with modern scientific equipment, which guarantees objective results. The doctoral student has learned new methods for modification of electrode materials, as well as the methods for their characterization, and has independently carried out a large part of the research that is reflected in the dissertation work. The obtained data is discussed correctly, which shows that the doctoral student has acquired skills for presenting results.

The main contributions of the presented dissertation are the following:

An electrochemical biosensor based on glassy carbon modified by electrochemical deposition of gold nanostructures and covalently bound laccase was obtained, and its practical application for quantitative analysis of dopamine and L-epinephrine in ampoules of injection solution was demonstrated.

For the first time, an electrocatalytic effect of Co-g-C₃N₄ in combination with conductive polymer „Nafion“ in the electrochemical reduction of hydrogen peroxide and tertiary butylhydroperoxide in a wide range of concentrations has been experimentally demonstrated. The developed peroxide electrode is applicable for determination of enzyme activity of catalase in a neutral medium, as

well as for determination of peroxide value of vegetable oils. Of particular importance is the developed faster electrochemical method for determining the peroxide value of vegetable oils, which has significant potential to be used as an alternative to standard titrimetric methods. In support of this is the submitted application for a patent invention "Electrochemical method for quantitative determination of peroxide compounds" with authors V. Kolcheva, N. Dimcheva, M. Stoyanova, M. Pimpilova.

I believe that the developed electroanalytical methods can find their practical application in the analysis of real samples.

Three generalized conclusions and 5 original scientific and scientific-applied contributions are presented. The conclusions and contributions fully correspond to the results obtained.

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

The list of Mariya Pimpilova's publications in connection with the dissertation includes 2 articles in journals, referenced and indexed in *Web of Science* and *Scopus*, respectively 1 of the publications is in a journal with Q2 (*Catalysts*) and 1 is in a journal with Q1 (*Biosensors*), as well as co-authorship in 1 patent application for invention: "Electrochemical method for quantification of peroxide compounds". Mariya Pimpilova's personal participation in these scientific works is based on the fact that in both the 2 of the publications the doctoral student is the first author.

The results of the conducted research were reported at seven international and national scientific forums. From the presented reports and posters, it can be seen that in 5 of them the doctoral student is the first author and in 2 she is the second author.

The 8 noticed citations of the two publications are to assess the quality of the conducted research, and it should be noted that they are by foreign authors. The publishing activity meets the requirements for acquiring educational and scientific degree "Doctor" - the minimum national requirements and the minimum requirements of the Regulations of the PU for the Academic Staff Development are over fulfilled, as the PhD student has applied 2 publications in referenced and indexed journals in *Web of science* and *Scopus* (45 points at required 30).

7. Abstract on dissertation

The abstract, which is 32 pages, corresponds to the content of the dissertation and is an abbreviated version of its essence, fully and accurately reflects the results achieved in the dissertation, and their analysis.

8. Recommendations for future use of dissertation contributions and results

I do not have critical remarks and recommendations for the conducted research and the presented materials. From the point of view of the great potential of these methods, I would recommend to continue research in this field and to consider their application in the determination of other biologically active compounds.

CONCLUSION

I believe that its relevance, use of modern research methods, achieved results and their interpretation, volume of work, number of publications, the presented dissertation *fully meets* all the requirements of the Academic Staff Development Act in the Republic of Bulgaria (ASDARB) and the Regulations for application of ASDARB, and the Regulations of University of Plovdiv "Paisii Hilendarski".

The dissertation shows that the doctoral student Mariya Genova Pimpilova *has* in-depth theoretical knowledge and professional skills in the doctoral program “Physical Chemistry”, *demonstrating* qualities and skills for independent research.

Due to the above, I confidently give my *positive assessment* of the study presented in the dissertation and *I propose to the esteemed scientific jury to award the educational and scientific degree "Doctor"* to **Mariya Genova Pimpilova** in area of higher education: 4. Natural sciences, mathematics and informatics, in professional field 4.2. Chemical sciences, in the doctoral program “Physical Chemistry”.

28.03. 2024

Statement prepared by:

Prof. Ginka Antova, PhD