

REVIEW

of dissertation for the acquisition of:

educational and scientific degree " doctor "	X
scientific degree " Doctor of Science "	
	the true is indicated by the sign "X"

Author of the dissertation:

		Artem	Vadimovich	Bezfamilnyi	Medical equipment service technician at "Medhouse Swiss Bulgaria"
academic position	scientific degree	name	middle name	last name	workplace

Topic of the dissertation:

Study of complexation equilibria involving metal ions and organic ligands: composition, sensing activity and application

Scientific area:

4.	Natural sciences, mathematics and informatics
code	name

Professional area:

4.2.	Chemical sciences
code	name

Scientific specialty:

4.2. Chemical sciences (Analytical chemistry)

The review was written by:

Associate Professor	PhD	Albena	Kirirlova	Detcheva-Tchakarova	IGIC-BAS
academic position	scientific degree	name	middle name	last name	workplace

1. Completion of the provided documents:

A) The dissertation and the competition documents are in full compliance with the Regulations.	4 points	X
B) The documents are complete but do not fully comply with the requirements of the Regulations.	2 points	

C) The documents are not completed in accordance with the requirements of the Regulations.	0 points	
		one of the answers given is marked with the sign "X"

Missing documents and violated standards must be described if response C is marked.

2. Meeting the minimum requirements under the Regulations:

A) The candidate meets the minimum requirements	20 points	X
B) The candidate doesn't meet the minimum requirements	0 points	
		one of the answers given is marked with the sign "X"

It must be filled in if answer B is marked. The publication activity of the candidate is analyzed. The response of the results achieved (quoted) is analyzed.

The PhD-student is co-author of 4 scientific publications, two of them with Impact factor and Quartiles, Q3 and Q1 respectively. For the first publication 5 citations are noted, for the second – one citation, which is a proof that the published results have already got international impact.

3. The relevance of the topic of the dissertation:

A) The topic is relevant and new (there are no known results on the topic by other authors)	8 points	X
B) The topic is relevant and results from other authors are known	6 points	
C) The topic is not relevant, but results from other authors are known	2 points	
D) The topic is not relevant and no results from other authors are known	1 point	
E) The topic does not correspond to the level of dissertation	0 points	
		one of the answers given is marked with the sign "X"

The evaluation of the relevance of the dissertation must be substantiated

Despite the fact, that the investigation of complex-forming equilibrium processes involving metal ions and organic ligands containing electron-donor groups for stable chelate binding is a widely exploited subject, my opinion is that the topic and objectives in the present PhD-thesis are relevant and new. A proof for this are the scientific works published in peer-reviewed journals by international academic publishers.

4. Knowledge of the problems, subject of research in the dissertation:

A) The doctoral student knows in detail the achievements of other authors on the topic of the dissertation	8 points	X
B) The doctoral student is partially familiar with the achieved results on the topic of the dissertation	4 points	
C) The doctoral student has no prior knowledge of the status of the problems in the dissertation	0 points	
		one of the answers given is marked with the sign "X"

The evaluation must be substantiated if answer C is marked.

The Literature review is extensive (it contains **246** literature sources) and demonstrates that the PhD-student knows in detail the achievements of other authors on the topic of the dissertation, knows very well the specific scientific issues and is fluent in the literature on the subject.

5. Type of research:

A) Theoretical	4 points	
B) Applied	4 points	X
C) Theoretical with application elements	4 points	
D) It does not correspond to the level of dissertation	0 points	
		one of the answers given is marked with the sign "X"

The level of research must be substantiated if answer D is marked.

The investigations in the present PhD-thesis are mainly applied type of research, but they have a serious theoretical background.

6. Objectives of the research:

A) Realistic and of scientific and / or applied interest	8 points	X
B) Realistic, but not of scientific and / or applied interest	3 points	
C) Unattainable (unrealistic)	0 points	
		one of the answers given is marked with the sign "X"

Objectives must be specified. The type of the set objectives must be justified.

The primary goal of the dissertation work is to investigate complex-forming equilibrium processes involving metal ions and newly synthesized derivatives of organic compounds from classes with a broad scientific response as chelating agents: hydantoin derivatives and azo-azomethine derivatives, as well as to studying the possibility of application of the investigated organic ligands as sensors for the detection of metal ions in real water samples.

7. Methods of research:

A) Adequate to research and set objectives	8 points	X
B) Partially appropriate, enabling part of the scientific objectives and / or applications to be achieved	4 points	
C) Inappropriate methods	0 points	
		one of the answers given is marked with the sign "X"

Methods must be specified. The type of methods used is justified.

In the present PhD-thesis investigations of equilibrium processes between metal ions and organic ligands in "model solutions" (hydantoin and azo-azomethine derivatives) are carried out. Voltammetry and UV-Vis spectrometry are used to characterize the obtained complex compounds. To prove the preparation of the complex compounds and to study the possibility of detection and determination of metal ions in real samples the methods differential pulse polarography (DPP) and cyclic voltammetry are used. The stability constants of complex compounds are determined by processing of the obtained spectrometric and voltammetric data. The stoichiometric composition of the complex compounds obtained, are determined spectrophotometrically. To obtain satisfactory results for the determination of the stability and stoichiometry of the studied complexes, Job's method for spectral data processing, as well as the functions of *DeFord*, *Hume* and *Leden*, were applied by processing voltammetric oxidation/reduction data of labile systems.

8. Contributions of the dissertation:

A) With lasting scientific and / or applied response, they form the basis for new research and applications	20 points	X
B) They are of significant scientific and / or applied interest, complete and / or summarize previous research	16 points	
C) They are of scientific and / or applied interest	12 points	
D) Lack of significant contributions	8 points	
E) Lack of contributions	0 points	
		one of the answers given is marked with the sign "X"

Contributions must be specified. The type of results achieved must be justified.

The scientific contributions in the present PhD-thesis are formulated as follows:
 New data concerning the complexation properties of the metal ions Cu(II), Pb(II), Ni(II) and Co(II) and multifunctional organic ligands were obtained, resulting in the investigation of 22 complex forms. Two new voltammetric methods for the detection and determination of Cu(II) ions using organic ligands-aminohydantoin/azo-azomethine derivatives are demonstrated in real samples. The methods are sensitive and selective, allowing for the determination of analyte micro-quantities directly in the sample without the need for preliminary extraction or separation. The developed methods are quick, precise, and accurate, and they make use of low-cost analysis equipment. Therefore I am convinced that the scientific contributions in the present PhD-thesis will be with lasting scientific and / or applied response and there is no doubt that they will form the basis for new research and applications.

9. Evaluation of the compliance of the dissertation summary with the dissertation:

A) Full compliance	4 points	X
B) Compliance of the main parts	2 points	
C) Lack of compliance of the main parts	0 points	
		one of the answers given is marked with the sign "X"

The evaluation must be substantiated if answer C is marked.

The dissertation summary presented by PhD-student Artem Bezfamilnyi correctly presents in a short and informative form the content of the dissertation, the goals and tasks, the main results and their discussion, the conclusions and the achievements.

10. Participation of the doctoral student in the achievement of the results of the dissertation:

A) The doctoral student has at least an equal participation	8 points	X
B) The doctoral student has secondary participation	5 points	
C) The participation of the doctoral student is unnoticeable	0 points	
		one of the answers given is marked with the sign "X"

Critical notes must be provided if one of the items B or C is marked.

I would like to express my satisfaction with the completeness, orderliness and precision of the materials submitted to me for review. Moreover, I was impressed by the presentation of Artem Bezfamilnyi and by the way he answered the questions thus demonstrating his knowledge on the subject. I have no doubt in his personal participation in obtaining the scientific results in the PhD-thesis.

11. Critical notes:

A) Lack of critical notes	8 points	X
B) Critical notes of a technical nature	7 points	
C) Critical notes that would partially improve the results achieved	4 points	
D) Significant critical notes	0 points	
		one of the answers given is marked with the sign "X"

Critical notes must be provided if one of the answers C or D is marked.

I have no critical remarks concerning the PhD-thesis, the abstract and other materials presented by Artem Bezfamilnyi, as well as his scientific and professional level.

12. Conclusion

A) The evaluation of the dissertation is POSITIVE	This evaluation is assigned to a total number of at least 65 points	X
B) The evaluation of the dissertation is NEGATIVE	This evaluation is assigned to a total number below 65 points	
		one of the answers given is marked with the sign "X"

To be filled in at the request of the reviewer

The PhD-Thesis contains **scientific and applied results which are original contribution in science** and **meet all the requirements** of the Law for Development of Academic Staff in the Republic of Bulgaria and the Regulations for implementation of the Law for the development of the academic staff in the Republic of Bulgaria. Due to the above, I am convinced to give my **positive assessment** to the research presented by the above reviewed PhD-thesis, abstract, results and contributions, and **I propose the esteemed scientific jury to award the educational and scientific degree "Doctor" to Artem Vadimovich Bezfamilnyi** in the Scientific area: **4. Natural sciences, mathematics and informatics**; professional field **4.2. Chemical sciences**; Scientific specialty **4.2. Chemical sciences (Analytical Chemistry)**.

	The review was written by:	
31.03.2023	Assoc. Prof. Dr. Albena Detcheva-Tchakarova	signature