Appendix 12a

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:

Eng.		Venezia	Nikolova	Garova	
academic position	scientific degree	name	middle name	last name	workplace

Topic of the dissertation:

Anodic behavior of Zn.

Scientific area:

4.1	Physical science
code	name

Professional area:

code	name

Scientific specialty:

Structural, mechanical and thermal properties of condensed materials

The review was written by:

Prof.	D.Sc.	Doriana	Ivanova	Malinovska	Emeritus prof. at CL SENES-BAN
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 presented in the eng. Venezia Nikolova Garova's thesis are published in 3 scientific papers, This is evaluated with 55 points, which exceeds the requirements of the Regulations - 20 points. She is the co-author of 2 publications in journals with SJR and 1 – in a book, published by Cambridge Scholars Publishing. 4 citations to two of the published articles were noted.

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
The conducted research, the results of which are presented in the PhD thesis, is related to the study of the anodic behavior of zinc, which is used for battery anodes, for the galvanic application of anti-corrosion coatings,corrosion protection of steel, for the production of pure zinc salts, of nanoparticles in order to create various instruments such as sensors, photodiodes, Schottky diodes and other practical applications. This determines the topic of the thesis as a relevant and new.

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 detailed literature review presented in the thesis demonstrates a thorough knowledge of the scientific research on the topic and the results conducted by the scientific community and published in the scientific literature over the past 55 years. Publications of well known Bulgarian researchers in the field of electrochemistry are also cited. The used literary sources are 227, published in the period 1957-2022.

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 research conducted to achieve the objectives of the dissertation is applied.

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 objectives of the dissertation work are well argued and realistic. The research is related to studying the anodic behavior of zinc in aqueous borate electrolytes and sodium-based aqueous solutions and characterization of the resulting layers. Studies of the dependence of the kinetics of the anodic behavior of zinc in aqueous borate electrolytes and of sodium-based aqueous solutions depending on the current density, composition and concentration of the forming electrolyte and the temperature at which the process takes place have been performed.

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.
The methods used have been very precisely chosen for conducting the research and contributed to the successful achievement of the objectives of the thesis. The following modern research methods have been used: X-ray diffractometry; reflection infrared spectroscopy; microraman spectroscopy; X-ray photoelectron spectroscopy; scanning electron microscopy; energy dispersive X-ray spectroscopy; atomic force microscopy.

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 contributions of the dissertation work are clearly presented and have the potential for the development of new directions in the field of development of new devices. The influence of the technological conditions of the process (concentration and composition of the electrolyte, current density, pH and temperature, addition of NaOH or NH_4OH, the concentration of H_3BO_3) on the process, properties and qualities of aqueous borate electrolytes has been established. It was found that for all used electrolytes the breakdown voltage decreases with increasing current density obeying the law of Burger and Wu. The results show that the deposited anode layers are amorphous and composed of $2ZnO.3B_2O_3.7H_2O$. It was concluded that the composition of the layers does not depend on the concentration of the forming electrolyte, as well as on how their pH is regulated. Based on the results of a scanning electron microscopy study, a model describing the film growth process was created. Measurements by inductively coupled plasma optical emission spectroscopy of the dissolved differential amount of electrode material confirm the role of accumulated mechanical stresses in the

kinetics of layer formation. X-ray diffraction spectra showed that the anode layer was composed of crystalline zinc oxide. X-ray photoelectron spectroscopy studies confirm that the layer consists of ZnO with minimal impurities in the form of hydroxides and/or carbonates or compounds. Observations by scanning electron microscopy and atomic force microscopy have shown that in the early stages of anodic polarization, before the inflection point, a film is formed that fills the irregularities on the electrode surface and it becomes smoother than after electropolishing. These results are important for the development of various instruments.

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 content of the thesis summary fully corresponds to the description of the objectives, experiments, obtained results, analyzes and conclusions presented in the thesis.

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 believe that the PhD student, eng. Venezia Nikolova Garova, has an important contribution in conducting the experiments and the presented the results of the research, which are included in the thesis, having at least equal participation. She has submitted a statement of authorship. She is a co-author of 3 publications in scientific journals and has participated with reports in 5 scientific conferences.

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.

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 results obtained in the thesis of eng. Venezia Nikolova Garova corresponds to the goals of the thesis and has a high contribution to the development of a new direction in the field of meterials techologies. The assessment with an asset of 100 points exceeds the requirements of HTMU for the acquisition of the scientific and educational degree "doctor". The performed research and the obtained results presented in the thesis characterize eng. Venezia Nikolova Garova as a young scientist capable to conduct independent research with important practical application. I give a "POSITIVE" evaluation of the presented thesis. Based on the conducted research and the presented results in the thesis of eng. Venezia Nikolova Garova, I propose with complete conviction to the scientific jury of the competition to vote "Yes" for the acquisition of the scientific-educational degree "doctor" in professional direction 4.1. Physical science, (scientific speciality: Structure, mechanical and thermal properties of condensed matter).

01.03.2025	Prof. D.Sc. Doriana Ivanova Malinovska	
date	The review was written by	signature