

**REPORT**

of dissertation for the acquisition of:

educational and scientific degree " doctor "	<b>x</b>
scientific degree " <b>Doctor of Science</b> "	
	the true is indicated by the sign "X"

**Author of the dissertation:**

		<b>Venetsiya</b>	<b>Nikolaeva</b>	<b>Garova</b>	
academic position	scientific degree	name	middle name	last name	workplace

**Topic of the dissertation:**

<b>ANODIC BEHAVIOUR OF ZINC</b>
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**Scientific area:**

4.	Natural sciences, mathematics, and informatics
code	name

**Professional area:**

4.1.	Physical Sciences
code	name

**Scientific specialty:**

Structure, mechanical and thermal properties of condensed matter
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**The report was written by:**

Prof.	Dr.	Victoria	Vitkova	Vitkova	ISSP-BAS
academic position	scientific degree	name	middle name	last name	workplace

**1. Meeting the minimum requirements under the Regulations:**

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

It is mandatory to fill in if answer B is marked. The publication activity of the candidate is analyzed. The response of the results achieved (quoted) is analyzed.

The results of Venetsiya Nikolaeva Garova's dissertation have been published in 3 (three) scientific papers: 1 (one) chapter of a book (Cambridge Scholars Publishing) and 2 (two) articles in the peer-reviewed journal Materials Chemistry and Physics (Elsevier), which is indexed in the databases Web of Science (Q2) and

Scopus (Q2). There have also been 4 (four) independent citations of the publications in Materials Chemistry and Physics (3 for the article from 2020 and 1 for the article from 2021). During her doctoral studies, Engineer Garova presented 5 (five) poster presentations at scientific forums, three of which were international. Based on the provided materials, the 55 points calculated according to indicators 7 and 8 of the candidate significantly exceed the required 30 points as per the Regulations for the Acquisition of Scientific Degrees and Academic Positions at the University of Chemical Technology and Metallurgy and Appendices to it.

## 2. 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	
B) The topic is relevant and results from other authors are known	6 points	X
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 study of the anodic behaviour of zinc is particularly relevant given the wide range of applications for the development of anticorrosive coatings, energy storage (batteries and supercapacitors), sensors, the chemical industry, semiconductor technology, biomedicine, and several others. In this context, the presented dissertation, dedicated to the study of the physicochemical processes occurring during the anodic polarization of zinc in aqueous borate electrolytes and aqueous sodium hydroxide solutions, stands out for its fundamental and practical significance. An element of novelty is the chosen galvanostatic mode of anodic polarization of zinc, which has not been sufficiently studied in the literature so far. The topic of the dissertation is especially relevant in relation to the scientific priorities outlined in the "National Strategy for the Development of Scientific Research in the Republic of Bulgaria 2017-2030" and is related to the priority area for applied scientific research in the fields of materials science and nanotechnology.

## 3. Type of research:

A) Theoretical	4 points	
B) Applied	4 points	
C) Theoretical with application elements	4 points	X
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 dissertation of engineer Venetsiya Garova presents original results from fundamental research with analysis and conclusions with practical significance and applied value.

## 4. 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"
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Objectives must be specified. The type of the set objectives must be justified.

The main objective set in the dissertation is realistic and of significant scientific and applied interest. It consists of studying the anodic behaviour of zinc in aqueous borate electrolytes and aqueous solutions of sodium hydroxide together with characterizing the obtained layers through elaborated spectroscopic and microscopic methods. The well-defined formulation of the tasks is noticeable, aimed at determining the dependence of the kinetics of the anodic behaviour of zinc in the studied electrolyte solutions, depending on the current density, composition and concentration of the forming electrolyte, and the temperature at which the process occurs. The chosen methodology, which includes infrared, Raman, and energy-dispersive X-ray spectroscopy, scanning electron and atomic force microscopy, enables both qualitative and quantitative determination of the composition of the obtained layers as well as investigation of their morphology depending on the physicochemical parameters (concentration and composition of the electrolyte, current density, pH of the medium, temperature). The results presented in the dissertation contribute to the development of electrochemical approaches for promising technological applications based on Zn.

### 5. 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 main contributions of Venetsiya Nikolaeva Garova's dissertation can be qualified as original scientific and applied scientific achievements. They are summarized in 17 points, which reflect in detail and completeness the achievements of the candidate. Some repetitions are found in the conclusions made such as the conclusions in positions 5 and 8, which should be combined. Several key groups of contributions stand out, as follows:

- Through anodic polarization of zinc in a galvanostatic mode, electrode processes were studied in aqueous borate electrolytes as well as in aqueous solutions of sodium hydroxide, with the experimental conditions being varied within the widest possible limits.
- Induction periods are evidenced in the obtained kinetic curves across the entire investigated range of current densities, concentrations, pH, and temperatures, with the duration of these periods being dependent on all these parameters.
- A correlation is revealed between the duration of
- the induction periods, current density, temperature, and pH of the medium. Conditions are identified under which the rates of film growth and dissolution become equal.
- The composition and structure of the obtained anodic layers are determined through Raman spectroscopy, X-ray diffraction, infrared spectroscopy, and X-ray photoelectron spectroscopy, with no dependence on the concentration of the forming electrolyte being observed.
- Data from scanning electron and atomic force microscopy of the electrode surfaces underlay a model describing the process of film growth. The duration of the induction period as a function of the concentration of the forming electrolyte is described.
- The effect of mechanical stresses on the morphology and structure of the layer and the generation of slow oscillations of the forming stress are revealed.

- The strong dependence of the kinetics of the anodic behaviour of zinc in aqueous solutions of sodium hydroxide on the concentration of the forming electrolyte is shown.

The results achieved in the framework of the dissertation provide a solid foundation for evaluating the potential of the obtained films for their practical application in various technological fields.

## 6. Conclusion

A) The evaluation of the dissertation is <b>POSITIVE</b>	This evaluation is assigned to a total number of at least 40 points	<b>X</b>
B) The evaluation of the dissertation is <b>NEGATIVE</b>	This evaluation is assigned to a total number below 40 points	
		one of the answers given is marked with the sign "X"

To be filled in at the request of the member of the scientific jury

The dissertation presented by Venetsiya Nikolaeva Garova meet all the requirements of the Act on Development of Academic Staff in the Republic of Bulgaria, the Regulations for its implementation act and the additional university regulations for application of the Act.

The scientific contributions of Venetsiya Garova's thesis testify to the possession of in-depth theoretical knowledge in condensed matter physics, as well as abilities for independent scientific research. Based on the above, I support the awarding of the educational and scientific degree "Doctor" to Venetsiya Nikolaeva Garova in 4.1. "Physical Sciences", scientific specialty "Structure, mechanical and thermal properties of condensed matter".

	The report was written by:	
date	Prof. Victoria Vitkova, ISSP-BAS	signature