Appendix 12d

REPORT

to occupy the academic position:

"Professor"	
"Associate Professor"	X
	one of the academic positions indicated shall be marked with the sign "X"

Candidates to occupy the position:

1	Chief Assistant	Ph.D.	Vasil	Ivanov	Karastoyanov	University of Chemical Technology and Metallurgy
№	academic position	scientific degree	name	middle name	last name	workplace

Scientific area:

4.	Natural Sciences, Mathematics and Informatics
code	name

Professional area:

4.2.	Chemical Sciences
code	name

Scientific specialty:

Physical Chemistry

The competition has been announced:

23	19.03.2023 г.		
in SG issue	date	for the needs of the Department	Faculty

The report was written by:

Professor	D.Sc	Tony	Georgiev	Spassov	Sofia University “St. Kl. Ohridski”
academic position	scientific degree	name	middle name	last name	workplace

1. Report for the candidate:

Chief Assistant	Ph.D.	Vasil	Ivanov	Karastoyanov
academic position	scientific degree	name	middle name	last name

1.1. 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.
In the current competition Chief Assistant Dr. Vasil Karastoyanov participated with 10 publications in journals referenced in the Scopus and Web of Science databases with an impact factor: 5 – in Q1, 4 – in Q2, 1 – in Q3. He presented a habilitation thesis, including six publications (3 - in Q1, 3 - in Q2). 157 citations have been noticed on the works of Vasil Karastoyanov, submitted for participation in the competition (Scopus, h index - 6). He is the author of one textbook.

1.2. Relevance of scientific and / or applied research:

A) The research is relevant. Part of the research is pioneering (no results are known on the topic by other authors)	8 points	x
B) Research is relevant. Results from other authors are known for each of the topics and / or applications studied.	6 points	
C) Most of the research is relevant, but also some results are presented that have no scientific and / or applied value	4 points	
D) The smaller part of the research is relevant	2 points	
E) Research is not relevant	0 points	
		one of the answers given is marked with the sign "X"

The evaluation of the relevance of the research must be substantiated.

The study of corrosion processes occurring on the surfaces of first and second loops of nuclear reactors is a topical task involving both theoretical and experimental aspects of materials science. The candidate has a clear scientific contribution to these problems. Another important scientific field, to which several publications of Dr. Karastoyanov are devoted, concerns the formation and modification of oxide films on niobium and tungsten, titanium and steels. The interest in these is mainly due to the possibility of forming nanoporous oxides having improved properties compared to any other form of these oxides for applications in catalysis, sensor development, photoelectrolysis and photovoltaics. For me, there is no doubt that Dr Karastoyanov's research falls into an area of physicochemical materials science of relevance to a range of applications in nuclear power and catalysis.

1.3. 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	4 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
In his scientific work, the candidate has clear and realistic goals, including both the modeling of oxide film growth on materials constituting the first loop of nuclear reactors and the elucidation of the corrosion mechanism in the second loop of nuclear power plants. Another objective in his research concerns the modelling of the formation processes of barrier oxide films on different metals, finding application in catalysis and photocatalysis. Common in the scientific approaches chosen by the candidate is the search for kinetic models describing quantitatively the investigated corrosion and barrier oxide film formation processes and, as a result, providing important information on their mechanism.

1.4. Candidate research contributions:

A) With lasting scientific and / or applied response, they form the basis for new research and applications	20 points	
B) They are of significant scientific and / or applied interest, complete and / or summarize previous research	16 points	x
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 studies conducted by Dr. Karastoyanov is characterized by the necessary depth in the search for an explanation of the mechanisms of the investigated corrosion processes and leads to significant results and scientific contributions. The research included in the candidate's habilitation thesis includes the modelling of the growth of oxide films on the surface of materials of the first loop of nuclear power plants, the influence of the water-chemical regime on the corrosion processes of fuel cladding in reactors cooled with pressurized water, as well as the elucidation of the corrosion processes and the formation of sludge in the second loop of nuclear power plants. In these studies, the candidate applies both advanced experimental methods, such as in-situ impedance spectroscopy and X-ray photoelectron spectroscopy, and modelling of corrosion processes. As a result, rate constants and diffusion coefficients of the elements constituting the oxide films were obtained. An extended kinetic model allowing quantitative evaluation of the effect of the water-chemical regime on the electrochemical properties of the film is also proposed. A quantitative corrosion model of zirconium alloys used as nuclear fuel cladding has also been developed. On this basis, dependences of oxide thickness and amount of incorporated hydrogen on time and temperature and water-chemical regime are derived. It is also found that the corrosion rate of carbon steel in the heat carrier of the second loop of pressurized waterpower plants is limited by the processes of charge load transfer and defect transport in the oxide. Another important area in which Karastoyanov's research leads to significant practical contributions concerns materials with applications in photocatalysis. Here again, a combination of experimental techniques and mathematical modeling has been used to characterize the formation and growth processes of oxide films on niobium and tungsten, titanium and titanium alloys, and steels. Without going into a detailed description of the new results obtained (reflected systematically in the author's reference on scientific contributions), I will focus only on those that, in my opinion, give a good idea of the level and depth of the research carried out by the candidate. A kinetic model describing quantitatively the growth/dissolution processes of oxide films on niobium and tungsten as well as the dissolution of the metal through the oxide has been developed and investigated by monitoring the steady-state current-potential curves and the impedance spectra of W and Nb over a wide range of potentials and pH. On this basis, a conceptual model of the nanopore initiation process at the film/electrolyte interface was also established. Interesting studies are also devoted to the formation of anodic oxide films on titanium and titanium alloys. The adsorption energy of a water molecule as a function of its orientation with respect to the metal surface has been evaluated by DFT simulations. The most stable orientation of water on the crystallographic plane (0001) of Ti was found, as well as the presence of dissociative adsorption of water molecules. The rate constants and diffusion coefficients characterizing the oxide growth processes, its dissolution and pore formation at the oxide/electrolyte interface were also calculated. A separate study proves that the oxide film on titanium alloy (Ti-Mo-Nb-Al) protects better against corrosion and dissolution but possesses inferior electronic properties than that on pure Ti. A group of 3 publications of the candidate focused on the synthesis and modification of oxides on stainless steels and titanium as photocatalysts for water decomposition. These fundamental studies are also characterized by scientific depth and a drive to elucidate the

mechanisms of the processes, but also have direct applied value. The chemical composition of the oxide film in depth of the steels as well as the electrochemical and photoelectrochemical properties of oxides formed by different methods (galvanostatic, mixed, tensiodynamic + galvanostatic, and potentiodynamic + potentiostatic) on stainless steel in ethylene glycol-fluoride electrolytes with low water content have been quantitatively characterized. Based on the results obtained, it is concluded that the oxides formed can be converted into highly efficient catalysts for aqueous electrolysis. Nanoporous titanium dioxide doped with molybdenum oxide is also considered as a promising photocatalyst for water decomposition, a topic addressed in another publication of the candidate. These oxides were again prepared by anodic oxidation in different electrolytes, and it was found that the deposition of molybdenum oxide in nanoporous titanium dioxide significantly improved the light absorption in the visible region. In conclusion, I believe with full conviction that the research carried out with Karastoyanov's major participation has both fundamental and significant applied scientific contributions.

1.5. Participation of the candidate in the achievement of the presented results:

A) The candidate has at least an equal participation in the submitted papers	8 points	x
B) The candidate has at least an equal participation in most of the submitted papers	7 points	
C) The candidate has a secondary participation in most of the submitted papers	4 points	
D) The candidate participation 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 C or D is marked.

1.6 Pedagogical activity:

A) The candidate has effective and sufficient pedagogical activity at the university. The textbooks issued are modern and useful (they meet the requirements of the Regulations). The work with undergraduate and doctoral students is at a high professional level.	8 points	x
B) The candidate has sufficient pedagogical activity at the university. The textbooks issued satisfy the requirements of the Regulations.	6 points	

C) The pedagogical activity and / or textbooks issued are insufficient (do not meet the requirements of the Regulations)	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.

1.7. 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 in a small part of the research	5 points	
D) Critical notes that would partially improve the results achieved in most of the research	3 points	
E) 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, D or E is marked.

1.8. Conclusion

A) The evaluation of the candidate's activity is **POSITIVE**	This evaluation is assigned to a total number of at least 50 points	x
B) The evaluation of the candidate's activity is **NEGATIVE**	This evaluation is assigned to a total number below 50 points	

		one of the answers given is marked with the sign "X"

To be filled in if requested by the member of the scientific jury
On the basis of the above, I suggest with full conviction that the Chief Asst. Dr. Vasil Karastoyanov to be elected as Associate Professor of Physicochemistry at the University of Chemical Technology and Metallurgy - Sofia.

01.07.2024	The report was written by:	TONY GEORGIEV SPASSOV Digitally signed by TONY GEORGIEV SPASSOV Date: 2024.07.01 08:50:14 +03'00'
date	**Tony Spassov**	signature