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	Assist. Prof.	PhD	Vasil	Ivanov	Karastoyanov	UCTM
№	academic position	scientific degree	name	middle name	last name	workplace

Scientific area:

4.	Natural sciences, mathematics, informatic
code	name

Professional area:

4.2	Chemical Sciences
code	name

Scientific specialty:

Physical Chemistry

The competition has been announced:

23	19.03.2014	Physical Chemistry	FHT
in SG issue	date	for the needs of the Department	Faculty

The report was written by:

Assoc. Prof.	PhD	Daniela	Simeonova	Tsekova	UCTM
academic position	scientific degree	name	middle name	last name	workplace

1. Report for the candidate:

Assist. Prof.	PhD	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.
Assist. Prof. Vasil Karastoyanov applies to the administrative position "Assoc. Prof." by presenting 16 scientific papers published in refereed and indexed in Scopus and/or WoS journals. Six of the scientific works correspond to the indicator 4 of the Law on the Development of the Academic Staff in the Republic of Bulgaria and the Regulations for its implementation at UCTM, and the remaining ten respond to indicator 7. He is the only author of a university textbook "Practicum on fuel cell technology", Publisher - HTMU, Published - 2024, 70 pages. The total number of citations of the scientific works of the Assist. Prof. Karastoyanov is 157. A list of 11 national and international conferences in which the candidate has participated in the last five years is presented. He has been entrusted with conducting numerous lecture courses. A list of six different lecture courses for both Masters and Bachelors students is presented. The total number of points of the required indicated activities is 734, with a minimum number of 400 points.

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.

Scientific works concern a topical area. A large part of it is dedicated to the research of the corrosion processes taking place on the first and second circuit of the reactors in the nuclear power industry and approaches to their limitation. Based on theoretical and experimental studies, appropriate models were created, and software for their application developed. The degree of relevance of these studies is visible by the fact that the created models and, accordingly, software for their application were implemented in the Kozloduy NPP in 2010 and 2021. The relevance of the studies is also confirmed by the 157 citations found.

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"

<table>
<tr><td>Objectives must be specified. The type of the set objectives must be justified</td></tr>
<tr><td>The research objectives derived from presented to me publications can be summarized as:
• Carrying out theoretical and appropriate experimental studies (in-situ impedance spectroscopy and ex-situ characterization of the thickness and chemical composition of the oxide layers with XPS) to quantitatively describe the corrosion processes occurring on
- surfaces of first and second loop of nuclear reactors,
- the fuel jackets in pressurized water nuclear reactors
- sludge formation in the second circuit of nuclear power plants
• Simulation of online NobleChem in fluidized bed nuclear reactors to more effectively reduce corrosion potential under hydrogen water chemistry conditions.
• Development, validation and verification of models for
- kinetics of oxidation of the fuel shells in the heat carrier of the first circuit
- formation of oxide films on niobium, tungsten, titanium and titanium alloys
• Synthesis and modification of steel and titanium oxides as photocatalysts for water decomposition
Obviously, these are realistic objectives and are of both scientific and applied interest.</td></tr>
</table>

1.4. Candidate research contributions:

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 have a scientific and applied nature. They concern mainly models development applying theoretical approaches, followed by their application in real systems. They can be presented as: Modeling of the growth and restructuring of oxide films on structural materials of the first circuit of nuclear power plants. The growth of the outer, deposited oxide layer is treated as a diffusion process in a matrix composed of the crystallites of this layer and the coolant between them. Based on the proposed model, software was developed for predicting the accumulation of radioactivity in the primary circuit of nuclear power plants, implemented in Kozloduy NPP in 2010. A quantitative model of the corrosion of zirconium alloys as nuclear fuel claddings has been developed, quantitatively describing both the processes during the stable growth of the protective oxide layer and the transitions between two periods. To develop, validate, and verify the model, long-term in-situ electrochemical measurements during oxide layer growth have been conducted in simulated first-loop water chemistry regimes of pressurized water power plants, from which a database of the corrosion behavior of the in-shell materials has been established. The model was validated by quantitative comparison with laboratory and operational data for pressurized water plants. Software has been developed for the application of the model, which has been implemented at Kozloduy NPP in 2021. A quantitative model of sludge formation and consolidation depending on the water chemical regime in the second circuit of nuclear power plants has been developed, parameterized, validated and verified. To verify the model, experiments were carried out to quantify the kinetics of magnetite deposition on AISI 316 steel in the second-loop aqueous-chemical regime using electrochemical impedance spectroscopy at different temperatures, which characterized the initial stages of the process very well. Software for the application of the model has been developed and implemented at Kozloduy NPP in 2021. A quantitative kinetic model of the formation processes of barrier oxide films on niobium and tungsten is proposed. Based on it, a conceptual model of the nanopore initiation process was developed. Processes of anodic oxide films formation on titanium and titanium alloys have been modeled. For the first time, in-situ photocurrent-time curves have been successfully measured for the $Ti/TiO_2/EG\text{-}H_2O\text{-}NH_4F$ system over a wide range of potentials and fluoride concentrations. A comparison of the anodic oxidation of a titanium alloy (Ti-15%Mo-3%Nb-3%Al) with that of pure titanium in an ethylene glycol-water-fluoride electrolyte was made by means of electrochemical impedance spectroscopy, photocurrent transients, photocurrent energy spectroscopy, light intensity modulation photocurrent spectroscopy and surface analyses. It is concluded that the oxide film on the alloy provides a better barrier against corrosion and dissolution but has poorer electronic properties than that on pure Ti. Synthesis and modification of steel and titanium oxides as photocatalysts for water decomposition have been performed. The in-depth oxide film chemistry, electrochemical and photoelectrochemical properties of anodic oxides formed by different methods (galvanostatic, mixed, tensiodynamic + galvanostatic and potentiodynamic + potentiostatic) on stainless steel in ethylene glycol fluoride electrolytes with low water content were quantitatively characterized. The oxides have a bilayer structure, with the inner layer enriched in Cr, Mo and Mn, while the outer layer contains predominantly Fe, with some Mn and Cu present. A maximum concentration of Ni is observed at the film/alloy interface. Online NobleChem simulation in fluidized bed nuclear reactors. Online NobleChem is a technology to reduce stress corrosion cracking of in-shell materials in fluidized bed nuclear reactors. To more effectively reduce the corrosion potential under hydrogen water chemistry conditions, solutions of noble metal salts (Pt) are dosed into the feed water during reactor operation. Based on corrosion potential measurements, scanning electron microscopy and LA-ICP-MS analyses, it was found that Pt deposition was more efficient at higher rates, resulting in lower potential and therefore better protection against stress corrosion cracking.

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	
B) The candidate has at least an equal participation in most of the submitted papers	7 points	X
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"

All presented results are developed by a team in which the candidate has equal participation.

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
Publications and activities, presented by Assist. Prof. V. Karastoyanov are sufficient in quantity and quality to cover the requirements of the Law on the Development of the Academic Staff in the Republic of Bulgaria and the Regulations for its implementation at UCTM. I give my positive vote to awarding him the the academic position of "Associate Professor" in the field of higher education 4. Natural sciences, mathematics and informatics; 4.2. Chemical Sciences (Physical Chemistry).

04.07.2024	The report was written by: **Assoc. Prof.** Daniela Tsekova	
date		signature