REVIEW

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	Ch.assist.	PhD	Maria	Atanassova	Petrova	UCTM
Nº	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:

Inorganic chemistry		

The competition has been announced:

101	27.12.2019	General Chemistry	and	Inorganic	Metallurgy Science	and	Materials
in SG	date	for the need	s of the D	Department	F	aculty	
issue							

The review was written by:

Prof.	DSc	Martin	Slavchev	Bojinov	UCTM
academic position	scientific degree	name	middle name	last name	workplace

1. Review for the candidate:

Ch.assist.	PhD	Maria	Atanassova	Petrova
academic position	scientific degree	name	middle name	last name

1.1. Completion of the provided documents:

A) The competition documents are in full compliance with the Regulations	3 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 requirements must be described if response C is marked.

1.2. Meeting the minimum requirements under the Regulations:

A) The candidate meets the minimum requirements	20 points	Х
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.

1.3. 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)	7 points	х
B) Research is relevant. Results from other authors are known for each of the topics and / or applications studied.	5 points	
C) Most of the research is relevant, but also some results are presented that have no scientific and / or applied value	3 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. In the presented scientific publications, synergism when extracting the metals from the Lanthanoids group was explored with mixtures of chelated extractants. In the open scientific literature, there is no other such comprehensive study. The interest in synergistic extraction is driven by the fact that extraction and ion-exchange methods play an important role in production and separation of 4f-metals. The successful selection of a combination of extractants in some cases leads to a 1-million increase in the degree of extraction of metals, and in some cases to better separation. The scientific value and actual importance of the research is confirmed by the more than 500 references from specialists working in the most significant scientific centers in chemistry of extraction processes.

1.4. Knowledge of the problems subject of research:

A) The candidate knows in detail the achievements of other authors on the researched topics and/or applications	6 points	х
B) The candidate is partially familiar with the achieved results on the researched topics and / or applications	4 points	
C) The candidate has no prior knowledge of the status of the researched problems	0 points	
		one of the answers given

	is marked with
	the sign "X"

The evaluation must be substantiated if answer C is marked.

1.5. Type of research:

A) Theoretical	4 points	Х
B) Applied	4 points	
C) Theoretical with application elements	4 points	
D) It does not correspond to the level specified in the Act for the Development of the Academic Staff in the Republic of Bulgaria and the Regulations	0 points	
		one of the
		answers given
		the sign "X"

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

1.6. Objectives of the research:

A) Realistic and of scientific and / or applied interest	8 points	Х
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.
1. Determination of the optimal conditions of the extraction of 4f-metals for systems and their combinations for which no literature data are available.

- 2. Clarification of the mechanism of extraction process and evaluation of the composition of the extracted complexes in the organic phase.
- 3. Assessment of equilibrium extraction constants and systematic analysis of factors influencing the equilibrium (ion radii of metals, nature of the chelating agent and synergists, etc.).
- 4. Assessment of synergetic coefficients and factors of separation of lanthanoids and systematic factorial parametric analysis.
- Analysis of the advantages and disadvantages of ionic liquids as extraction media for 4f-Metals – influence of the extent of mutual solubility and ion exchange on the extraction mechanism. The objectives are of a markedly fundamental scientific nature and, as demonstrated by the results obtained, fully realistically achievable.

1.7. Methods of research:

A) Adequate to research and set scientific objectives and /or applications	8 points	х
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 presented papers, classical and modern methods for research of liquid extraction mechanisms (spectrophotometry, potentiometry, spectroscopy of nuclear-magnetic resonance, coulonometry), as well as various methods for synthesis of extractants and elaboration of extraction procedures. The combination of methods used allows assessment of thermodynamic and kinetic parameters of the studied processes with high confidence and allows for a range of general conclusions to be drawn and verified.

1.8. 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	х
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.

- 1. The most significant scientific contribution of the research presented by Dr. Atanassova is that synergism in the extraction of metals from the entire 4f series is studied, while most of the papers of other scientists are limited to individual metals. Similar studies covering the full group of lanthanoids by other authors are very scarce. As it is well known that the chemical properties of the 4f-metals are very similar, so the detailed knowledge of their insignificant differences is decisive for their extraction and separation.
- 2. It was found that in the extraction of lanthanoids with mixtures of chelated extractants and various synergists, there both the extraction and separation degrees increase. A significant part of the studies (8 articles) concern the extraction processes of extracting 4f-metals with the use of Crown-ethers as synergistic additives. During these studies, several conclusions have been drawn regarding the role of these additives in the extraction process and the influence of the nature of the synergists on its mechanism and selectivity. The main conclusion is that crown ethers are effective synergists with very well-expressed selective properties.
- 3. Equilibrium extraction constants are appreciated, with a decrease in ionic radiuses of the cations. With an increase in the atomic number, ionic radii decrease at constant charge, i.e. charge density increases and the formation of the extracted complex is favored.
- 4. β-diketones were synthesized and both their individual complexing abilities and those in combination with phosphorus-containing OXO-donors were assessed. It was found that the addition of a second ligand increased the extraction efficiency with a large synergism (10³-10⁴).
- 5. Two-phase aqueous ionic liquid (A IL) systems have been investigated in terms of solubility water and acid in the IL phase and IL in the aqueous phase. The results give accurate quantitative information about the mutual solubility of two-phase systems in terms of water and IL, as well as the thermodynamic equilibria between the two phases. In the specific conditions, the main factor influencing these equilibria is the length of the alkyl chain of the imidazolium cation.
- 6. A detailed study on the possible interactions between the series of imidazolium ion liquids and commonly used extractants to separate 4f and 5f-ions featuring acidic chelating and neutral ligands uniquely demonstrates that no interaction has occurred between the ionic liquid and the extractant irrespective of the length of the alkyl chain of the IL, as well as the structure and acidity of the ligand.
- 7. The advantages and disadvantages of ionic fluids in the extraction processes and environmental challenges that are associated this new organic ionic environment are investigated in detail. The main contribution is the acquisition of analytical data for the transfer of ions, components of the IL, in the aqueous phase and their impact on the extraction mechanism of the 4f-metals.

1.9. 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	Х
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
		is marked with
		the sign "X"

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

1.10. 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	Х
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.

1.11. Critical notes:

A) Lack of critical notes	8 points	Х
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.

1.12. Conclusion

A) The evaluation of the candidate's activity is POSITIVE	This evaluation is assigned to a total number of at least 65 points	х
B) The evaluation of the candidate's activity is NEGATIVE	This evaluation is assigned to a total number below 65 points	
		one of the
		is marked with the sign "X"

To be filled in if requested by the reviewer

Based on the comments made on the scientific papers and the accumulated points, I strongly suggest the academic position "Associate Professor" in Inorganic Chemistry, professional domain 4. 2. Chemical Sciences, professional field 4 Natural Sciences, mathematics and Informatics to chief assistant Dr. Maria Atanassova Petrova.

15.05.2020	The review was written by:	
date	Prof. DSc Martin Slavchev Bojinov	signature