



time lecturer (Associated Professor) is 15.11.2013 г. Therefore, upon submission of the documents Dr. Petkova has occupied the academic position Associated Professor at NBU for six years, e.g. more than the five years' period required by the normative documents.

3. The publications submitted for the competition do not repeat those submitted for doctoral degree and the academic position of the Associate Professor.

4. There is no evidence of plagiarism in scientific works, presented by Dr. Petkova for participation in the current competition.

5. The evaluation of the presented materials demonstrates that Dr. Petkova covers, and for some indicators significantly exceeds the national requirements (Low\*), as well as the enhanced criteria of the Bulgarian Academy of Sciences and the Institute of Mineralogy and Crystallography (BAS/IMC\*\*) for the acquisition of the academic position Professor in the scientific field 4.2. Chemical Sciences. The correspondence of the applicant's points to the required points for the indicators in each group is presented in the table below.

Group	Indicators	Minimum points required for each group		Applicant's points	Total applicant's points for the groups
		Low*	BAS/IMC**		
A	1. PhD thesis	50	<b>50</b>	50	<b>50</b>
B	3. Habilitation work - scientific publications in journals referenced and indexed in WoS and Scopus	100	<b>100</b>	115	<b>115</b>
G	7. Scientific publications in journals referenced and indexed in the WoSand Scopus, outside the habilitation	200	<b>220</b>	331	<b>331</b>
D	11. Citations in scientific publications, monographs, collections, and patents referenced and indexed in the WoS and Scopus	100	<b>120</b>	192	<b>192</b>
E	13. Guidance of successfully defended PhD students			25	
	14. Participation in national scientific or educational projects			50	
	16. Guidance of national scientific or educational projects			80	
	17. Managing the Bulgarian team in international scientific or educational projects			100	
	18. Funds received from projects led by the candidate			166.63	
	Total for group E	150	<b>150</b>	421.63	<b>421.63</b>
<b>Total</b>		600	<b>640</b>	1109.63	<b>1109.63</b>

\* Law on the development of the academic staff in the Republic of Bulgaria

\*\*Regulation for the terms and procedures for acquisition of scientific degrees and appointing academic positions in Bulgarian Academy of Sciences / Rules for the terms and procedures for acquisition of scientific degrees and appointing academic positions in IMC-BAS

### **III. Brief analysis of the presented materials**

The total number of applicant's publications is 173, among them - 75 in impact factor journals, and 98 in non-impact factor journals and conference reports. According to the WoS and Scopus databases, Assoc. Prof. Petkova has co-authored 66 scientific papers published in the period 1990-2019, with 65% of them published over the last 10 years. According to the Scopus database and after excluding auto-citations, 348 citations were noticed, and the H-index of the applicant is 11.

Assoc. Prof. Petkova participates in the competition with 26 publications. Six of them (group B, №№ 4.1-4.6 from Table 4 in the file "10\_Spravka\_Naucna\_Deinost\_Tables\_1-4.pdf") comprise her habilitation work. These scientific papers are published in journals included in WoS and/or Scopus, with one of them (№ 4.5) being in the highest (Q1) category. Assoc. Prof. Petkova is the first author of 2 (33%) of these 6 publications. Twenty of the papers presented (group G, №№ 7.1-7.20) are outside the habilitation work. All of them are categorized in quartiles by WoS and Scopus (1 of them in Q1, 6 - in Q2, 10 - in Q3, and 4 - in Q4). The contribution of Dr. Petkova to these publications is highlighted by the fact that in 13 (65%) of these 20 publications she is the first author.

96 independent citations were noticed on the publications submitted to the competition. Out of these citations 31 are on papers included in the habilitation work.

The scientific achievements of Assoc. Prof. Petkova, obtained after taking the academic position Associated Professor, has been widely spread out through participation in 55 international and 14 national scientific events (conferences, symposiums, congresses and workshops). However, the candidate's omission is that there is no information in the documents about type of participation (personal or via co-authors) and presentation (poster, oral, others) for each material.

Assoc. Prof. Petkova has an active participation in the education. She was a full-time lecturer at NBU for the past 6 years giving lectures on Ecology program to BSc and MSc students. She was also a lecturer at the PhD Training Center unit at BAS (lecture course "Thermal analysis" for MSc and PhD students). She was a co-supervisor of one PhD student (2013).

The project activity of Dr. Petkova is also impressive. She was the head of 4 and participant in 5 national scientific projects; head of 1 international project; and head of the Bulgarian team of another international project. The amount of the funds under the projects she coordinated is over 830 thousand BGN.

It is also worth mentioning the expert activity of Dr. Petkova. It includes: expert reports in the field of thermal methods of investigation; participation in work groups for BSc and MSc programs accreditation in professional field "Earth Sciences" and PhD program "Mineralogy and Crystallography"; participation in scientific juries on number of completions; reviewer activity, etc. She is also a member of the Executive committee of Bulgarian National Science Fund at Ministry of Education and Science since October, 2019.

### **IV. Summary of the scientific achievements of the candidate**

The scientific activity of Assoc. Prof. Petkova is related to application of physicochemical methods for modification of the properties and characterization of structural and phase transformations

in natural resources and synthetic or waste inorganic materials with potential new applications (in construction, bio-agriculture, medical practice, ecology, etc.). The emphasis in her publications are the methods for intensification of the phase transitions and solid-phase synthesis in the systems studied (activation methods, thermal methods, use of additives in solid or gas phase), as well as the methods for identification of structural and thermal characteristics and phase transformations (thermal analysis, powder x-ray diffraction, infrared spectroscopy, scanning electron microscopy). Assoc. Prof. Petkova is a leading specialist in the field of thermal analysis (TG-DTG-DTA/DSC). Her scientific achievements on the mechanism of chemical reactions in natural and synthetic systems can be assessed as enrichment of existing knowledge using new methods and approaches, as well as finding and verifying new facts and relations for the processes studied.

### ***Habilitation work***

For the present competition, Dr. Petkova presents 6 scientific papers (№№ B4.1-4.6) as a habilitation work entitled: “*Modeling of natural mineral and technogenic systems for application in the construction*”. The subject is up to date and it is in line with European and National scientific priorities, and the results of the research have both basic and applied scientific values. The essence of the study consists in optimization of cement compositions (based on gray and white cements) through: (i) use of waste materials as mineral fillers (dolomite, eggshells, marble powder, natural zeolites) and polycarboxylate as an additive; (ii) variations in water-cement ratio, quantity and type of mineral fillers and additives; (iii) use of different activation methods, namely grinding, thermal treatment, others. The purpose of the study is to enhance the chemical activity and binding properties of the fillers and additives used; to improve the physicochemical properties (compressive strengths, density, hardness) of the mortars, as well as to reduce the carbon emissions during cement pastes production in combination with recovery of mineral wastes from different industries.

The main scientific achievement of the candidate in this study consists in clarification of the mechanism of solid-phase reactions during thermal treatment of the cement mortars used (formation of crystalline and x-ray amorphous hydrated phases; intermediate and final products of the thermal decomposition in the temperature range 450-900°C; microstructure of the solid phase, etc.) using the full functionality of the thermal methods (TG-DTG-DTA/DSC) in conjunction with the data from qualitative mass-spectroscopic analysis of the evolved gases.

### ***Publications outside of the habilitation work***

Assoc. Prof. Petkova presents 20 publications outside of the habilitation work (G group publications) for participation in the competition. They are thematically connected and represent studies on thermochemistry of natural and synthesized apatites and their composites with waste ammonium sulphate or natural zeolites. Thermo- and triboactivation was applied and its influence on structure of these materials was studied. Dr Petkova is the first author in 13 of these publications and she has a basic contribution for elucidation of the chemical reactions taking place during thermal decomposition of the objects studied. The publications can be grouped in four more specific thematic directions according to the object of investigation, and the main scientific achievements of the candidate for each of them are summarized below according to the reviewer's opinion:

Thermochemistry of apatite group minerals and their synthesized analogues. Results, related to this thematic direction, are included in all G group publications (№№7.1-7.20) as a part of the initial characterization of the composition, structure and thermal behavior of the samples studied. Sedimentary phosphorites from Tunisia, Syria and Estonia used in these countries for production of phosphate fertilizers were studied. It was confirmed by thermal analysis that their composition corresponds to carbonate-hydroxyl-apatite (COHFAp), type B. On the other hand, samples of synthesized fluor-hydroxyl-apatite (№7.18) and hydroxyl-apatite (№7.19) were studied, and minimal amounts of crystallization and structural water were found in their structure during thermal decomposition. The candidate's scientific achievement consists in detail elucidation of the mechanism of chemical reactions during thermal decomposition of the apatite group minerals and their synthesized analogues using thermal analysis combined with mass- and infrared- spectroscopic analyses of the evolved gases.

Thermochemistry of activated apatite group minerals and their synthesized analogues. Results, related to this thematic direction, are included in 16 publications (№№7.4-7.19). Intensive mechano-chemical activation with varying of its parameters was applied on Tunisian apatite (4 publications: №№7.4, 7.5, 7.9, 7.11) and Syrian apatite (6 publications: №№7.6, 7.7, 7.8, 7.12, 7.13, 7.14), as well as on synthesized fluorhydroxylapatite and biphasic Ca-phosphate ceramic (2 publications: №№7.18, 7.19). The scientific achievements of Dr. Petkova for this group of publications involves identification of the structural and phase transitions in the activated samples for different temperature ranges using the thermal analysis (TG-DTG-DSC/DTA) results; as well as presenting series of chemical reactions which describe the suggested mechanism of solid phase synthesis and isomorphic substitutions in the apatite structure. Some relations between experimental conditions, activation parameters, samples' origin and the rate of apatite structural deformation, respectively its reactivity, were established. The results represent a scientific basis for design of modified apatite materials with application in bio-agriculture as new type time-delayed and balanced fertilizers and soil amendments, as well as in the dental and orthopedic practices as medical ceramic with better biological compatibility.

Thermochemistry of activated composites of apatite and wasted  $(\text{NH}_4)_2\text{SO}_4$ . Four publications (№№7.1-7.3, 7.16) with an applied significance describe the possibility for production of new ecologically safe complex fertilizers (NPS, NPKS) by applying of thermal and high-energy milling of Tunisian phosphorite mixed with ammonium sulphate obtained as a waste by-product from number of industrial processes in Bulgaria. It was proven that the activation led to an increased reactivity of the samples, and the solid-phase reactions between the system' components took place at lower temperatures to form  $\text{NH}_4$ -Ca-phosphates and pyrophosphates. The scientific achievements of Dr. Petkova for this investigation are related to the study of thermal behavior of the system in the temperature interval 20-1200°C, which enriches our knowledge about these materials and opens new perspectives for improvement of the technology for their production.

Thermochemistry of activated composites of apatite and natural or ion-exchanged zeolite (clinoptilolite). Two publications (№№7.10, 7.11) describe series of experiments on tribochemical mixing and tribochemical activation of Tunisian phosphorite mixed in different proportions with clinoptilolite (Beli Plast, Bulgaria) or  $\text{NH}_4$ -exchanges forms of the same zeolite. The optimal compositions and ranges of thermal stability of the mixtures, the optimal parameters of mixing and

activation, and influence of the impurities on the degree of transformation of non-assimilated into bio-assimilated  $P_2O_5$  were established. Dr Petkova' achievements are related to elucidation of the processes' mechanism and the reasons for increasing apatite solubility in different cases of mixing and activation. The methods used are proposed as appropriate ones for application in extensive production of easily assimilated by plants phosphate fertilizers.

## **V. Opinions, notes and recommendations**

Some insignificant omissions and terminological inaccuracies are noticed in the publications and documents presented; however, they do not change my general good impression on the candidate's publication work, as well as my personal opinion about Assoc. Prof. Petkova as a highly motivated and productive scientist with impressive teaching, project, and expert activity.

## **VI. CONCLUSIONS**

The analysis of the documents submitted by Assoc. Prof. Vilma Petkova for participation in the competition for professorship, shows that the level of her scientific, teaching, and expert activity, as well as her science-metric indicators correspond to the requirements of the normative documents for taking up the academic position „Professor“ at the Institute of Mineralogy and Crystallography. The research topic of Assoc. Prof. Petkova is fully in line with the topic (Thermochemistry of natural and synthetic inorganic compounds) of the laboratory "Thermal analysis" at Department "Experimental Mineralogy and Crystallography" in IMC-BAS, whose needs the competition was announced.

On the basis of the above considerations I convincingly propose to the honorable members of the scientific jury to recommend Assoc. Prof. Dr. Vilma Petkova Stoyanova to be given the academic position “Professor” in the professional field 4.2. Chemical Sciences for the needs of Department "Experimental Mineralogy and Crystallography" at Institute of Mineralogy and Crystallography – BAS.

Reviewer:

(Prof. Christina Vassileva)

Sofia, 17.02.2020