

REVIEW

on a competition for the academic position "Associate Professor"
in a professional field 4.2. "Chemical Sciences"
("Solid State Chemistry, Nanoscale Materials and Minerals")
for the needs of the Department of Structural Crystallography and Material Science"
at the Institute of Mineralogy and Crystallography "Acad. Ivan Kostov" (IMC) – BAS,
published in "State Gazette" issue 106/15.12.2020

Reviewer: Prof. eng. Vilma Petkova Stoyanova PhD, IMC-BAS, Member of the Scientific jury appointed by Order №28PД-09/12.02.2021

In the competition for the academic position (AP) "Associate Professor" in the scientific specialty "Solid State Chemistry, nanomaterials and minerals" in professional field 4.2 "Chemical Sciences" ("State Gazette" issue 106/15.12.2020) participates one candidate – Assistant Professor Katerina Lyubomirova Zaharieva PhD, from the Laboratory "Modern Oxidation Processes" at the Institute of Catalysis, BAS.

1. Short biographical data on the applicant

Assistant Professor. Katerina Lyubomirova Zaharieva PhD, graduated in 2002 from the Faculty of Chemical Sciences of Sofia University, "St. Kliment Ohridski" (Diploma Serie A-2002 SU, No. 160590) as a "Master" in the specialty "Chemistry" with a professional qualification "Chemist". In 2010 she received the educational and scientific degree (Education Scientific degree) "PhD" in the scientific specialty 01.05.18 "Solid State Chemistry" (Diploma No 34582/06.12.12. 2010) after successful presentation of the dissertation on the topic: "Physicochemical characterization of plasmochemically synthesized nanodispersed inorganic powders" as a part-time PhD student at the Institute of Catalysis, BAS. From 2002 to 2008 she worked at University of Mining and Geology "St. Ivan Rilski", as a junior expert, and after 2004 as a senior expert. Since 2008 she has been appointed to the position of "Chemist" at the Institute of Catalysis at BAS. In 2011 she covered the conditions laid down by law and was appointed to the position – Assistant Professor to the Laboratory "Advanced Oxidation Processes" at IC-BAS, which she occupies to date.

2. Compliance of the documents submitted for the position of Associate Professor.

Protocol No110HO-05-06/16.02.2021 certifies the regularity and conformity of the documents.

1. Assistant Professor Katerina Lyubomirova Zaharieva PhD has provided all required documents for the academic position "Associate Professor" in accordance with Art. 19, item 1-7 of the Law on the Development of Academic Staff in the Republic of Bulgaria (in force as of 05.05.2018) and with Art. 53, para. 1 of its Implementing Regulations (effective as of 06.07.2018).
2. Assistant Professor Katerina Lyubomirova Zaharieva PhD is listed in the NACID (<https://ras.nacid.bg/dissertation-preview/37705>), with a recognized educational and scientific degree "PhD" on the basis of Diploma No 34582/06.12.2010, issued by Higher Attestation Commission.
3. According to the presented Certificate No1/04.01.2021, issued by IC-BAS, the candidate has held the academic position "Assistant Professor" for 9 years and almost 6 months in the professional department of "Chemical Sciences", which

satisfies the requirement for more than 2 years of internship in the academic position “Assistant Professor”.

4. The publications submitted for the competition shall not be duplicated with the publications for the acquisition of the Education Scientific Degree “PhD” and for the loan of academic position “Assistant Professor”.
5. There is no evidence of plagiarism in the scientific papers of Assistant Professor Katerina Lyubomirova Zaharieva PhD for participation in this competition.
6. The applicant has applied a reference for implementation of the minimum national requirements under Art. 2b, para 2 and 3 of the Law on The Development of The Academic Staff in The Republic of Bulgaria, as well as the increased criteria under Art. 11 para. 6 of Regulations for application of the Law for the development of the academic staff in the Republic of Bulgaria in the Bulgarian Academy of Sciences (effective as of 29.10.2018) in connection with Art. 2b, para. 5 of the Law on The Development of The Academic Staff in The Republic of Bulgaria and under Art. 18, para 2 of Regulations for application of the Law for the development of the academic staff (effective as of 26.11.2019) of the Institute of Mineralogy and Crystallography, BAS.
7. The analysis of the provided data shows that Assistant Professor Katerina Lyubomirova Zaharieva PhD covers and by some indicators exceeds the national requirements (the Law on The Development of The Academic Staff in The Republic of Bulgaria*), as well as the inflated criteria of the Bulgarian Academy of Sciences and the Institute of Mineralogy and Crystallography (BAS/IMC**) for the employment of academic position “Associate Professor” in professional field 4.2. “Chemical sciences”. The performance of the indicators by points shall be presented in the following table:

Group by Groups	Indicators	Minimum points required for each group		Points of applicant
		Law *	BAS/IMC**	
A	1. Dissertation on the award of an educational and scientific degree PhD	50	50	50
B	3. Habilitation work - scientific publications in publications that are referenced and indexed in WoS and Scopus	100	100	162
Г	7. Scientific publication in publications referenced and indexed in WoS and Scopus, outside of habilitation work	200	220	277***
Д	11. Citations in scientific publications, monographs, collective volumes and patents referenced and indexed in WoS and Scopus	50	60	168
Total		400	430	657***

* The Law on the Development of Academic Staff in the Republic of Bulgaria

** Rules for the terms and conditions for acquiring scientific degrees and for holding academic positions in the Bulgarian Academy of Sciences / Rules of Procedure for acquiring scientific degrees and for holding academic positions at IMC-BAS

*** Reduced value (item 4.2)

3. Description and analysis of the submitted materials

The total number of publications of Assistant Professor Katerina Lyubomirova Zaharieva PhD is 69 according to the full list of publications. For participation in the competition for academic position “Associate Professor” she presented 54 of them. The detailed scient metric report shows that 11 (20%) of the articles are in international journals, 43 (80%) in national journals. According to the list of publications Assistant Professor Katerina Lyubomirova Zaharieva PhD is a co-author of 32 (59%) scientific work visible in the world databases WoS and Scopus with scientific information, of which 29 (54%) articles are in journals with impact factor, 3 (5%) - in journals with impact rank and 22 (41%) - in full text in conference collections and in journals without impact factor. To cover the minimum requirements of Art. 2b, para. 2 of The Law on the Development of Academic Staff in the Republic of Bulgaria and the additional requirements of BAS and IMC-BAS for academic position “Associate Professor” are used only the articles found in WoS and Scopus. The distribution of articles by quartile of WoS and Scopus journals- in which the publications are published - is as follows: 3 articles are in Q1 journals; 5 in Q2 journals; 3 in Q3 and 18 in Q4 journals. They are among the high-ranking journals as follows: *Ceramics International (Q1)*, *Materials Letters (Q1)*, *Materials Chemistry and Physics (Q2)*, *American Mineralogist (Q2)*, *Archives of Pharmacal Research (Q2)* and *Comptes rendus de l'Académie bulgare des Sciences (Q2)*. The journal in which the largest number of the candidate's scientific publications are published is *Bulgarian Chemical Communications (Q4)* – 18 publications.

All publications of the Assistant Professor Katerina Lyubomirova Zaharieva PhD are co-authored with the participation of 54 co-authors. In 25 of the publications the candidate is the first author, in 24 – second, in 1 – third, in 2 – fourth and in 2 – fifth author. In 21 of the publications, Assistant Professor Katerina Lyubomirova Zaharieva PhD is a corresponding author and 2 articles are overview. In 2015 and 2018, the candidate developed the most active audience activity, publishing 16 articles in 2015 and 8 in 2018, after which there was a sharp decline in its publication activity.

The number of observed citations on Assistant Professor Katerina Lyubomirova Zaharieva's publications, presented in a separate list, is 95. Of these, 84 of them are in scientific publications, referenced and indexed in world-renowned databases of scientific information Scopus and WoS, and 11 are citations in other publications. The Hirsch index (h) according to Scopus is 5, and for the publications of the competition, it is also 5. The total number of points quoted in scientific publications referenced and indexed in world-renowned databases of scientific information Scopus and WoS, presented in the Report on the fulfilment of the minimum criteria, is 168. This result exceeds the required 60 points.

The scientific results of Zaharieva's research, obtained after the acquisition of the academic position “Assistant Professor”, are widely promoted through participations in 102 scientific forums, of which 45 in international scientific forums with 41 poster and 4 oral participations, 39 - in national conferences with 36 poster and 3 oral participations and 13 participations in other symposiums, congresses, etc.

Assistant Professor Katerina Lyubomirova Zaharieva PhD participated actively in 13 scientific projects, being the head of a contract funded by the budget subsidy of BAS on the topic: “Synthesis of oxide materials with application in photocatalysis” in the period 2018-2020. She is a participant in the working teams of 9 other contracts, financed by the NSF, in 2 - with funding from the University of Mining and Geology “St.

Ivan Rilski” and in contract BG051PO001-3.3.06-0050 “Creation of highly qualified specialists in modern materials for environmental protection: from design to innovation”, funded by the European Social Fund, under operational program “Human Resources Development” 2007 - 2013.

4. Main scientific and/or scientific - applied contributions

The contribution of the publications with which the candidate participates in the competition is considered in the two main categories of materials according to the requirements of Art. 2b, para. 2 and 3 of the Law on the Development of Academic Staff in the Republic of Bulgaria and under Art. 18, para. 2 of the Rules for the terms and conditions for acquiring scientific degrees and for holding academic positions in the Bulgarian Academy of Sciences / Rules of Procedure for acquiring scientific degrees and for holding academic positions at IMC-BAS: category “B” - Habilitation author's report on the contribution nature of the publications *included in the Habilitation Work, (item 4) and category “T” - Author's reference on the contribution nature of the publications by indicator, (item 7).*

4.1 *The Habilitation Author's Report on the indicators in category “B” summarizes the contributions from 11 publications (B.4.1-B.4.11, respectively №№18-20, 22, 30,33, 37, 38, 45, 47, 49 from the list of publications). Eight other publications (№№ 8, 9, 11-13, 15, 16, 26, 34) have been added to this publication group, which are thematically and methodically linked to the publications in the Habilitation Report. The added publications do not meet the requirements of the of the Law on the Development of Academic Staff in the Republic of Bulgaria and the Rules for the terms and conditions for acquiring scientific degrees and for holding academic positions in the Bulgarian Academy of Sciences / Rules of Procedure for acquiring scientific degrees and for holding academic positions at IMC-BAS under the competition and this makes them inapplicable. The publications presented in this group of indicators contribute 162 points to the required 100 points. According to the articles of this group, 57 quotes were noted in the world databases WoS and Scopus, as publication No C.4.1 collects the highest number of citations - 36.*

The main scientific field of publications in the Habilitation Author's Report of Assistant Professor Katerina Lyubomirova Zaharieva are synthesis and study of oxide nano-sized materials (mixed oxides, oxides, composite materials based on oxides with representatives:

- Aluminates with spindle structures in the Mg-A-O system, (B.4.3);
- Copper ferrite materials $\text{Cu}_x\text{Fe}_{3-x}\text{O}_4$, ($0 < x < 1$), (B.4.1);
- Cobalt-copper ferrite materials ($\text{Co}_{0.25}\text{Cu}_{0.25}\text{Fe}_{2.5}\text{O}_4$, $\text{Co}_{0.4}\text{Cu}_{0.1}\text{Fe}_{2.5}\text{O}_4$, $\text{Co}_{0.5}\text{Cu}_{0.5}\text{Fe}_2\text{O}_4$), (B.4.2)
- Nickel-containing ferrite materials $\text{Ni}_x\text{Fe}_{3-x}\text{O}_4$ ($x = 0.25, 0.5, 1$), (B.4.5);
- Zinc and manganese ferrite materials - $\text{Zn}_x\text{Fe}_{3-x}\text{O}_4$, $x=0.5, 1$ and $\text{Mn}_x\text{Fe}_{3-x}\text{O}_4$, ($x=0.25, 0.50, 1.00$), (B.4.4 and No15);
- Nano-sized substituted magnetite type materials, applied to activated carbon (AC) from peach pits ($\text{Cu}_{0.5}\text{Fe}_{2.5}\text{O}_4/\text{AC}$, $\text{Mn}_{0.5}\text{Fe}_{2.5}\text{O}_4/\text{AC}$, $\text{Co}_{0.5}\text{Fe}_{2.5}\text{O}_4/\text{AC}$ and $\text{Ni}_{0.25}\text{Fe}_{2.75}\text{O}_4/\text{AC}$, $\text{Ni}_{0.5}\text{Fe}_{2.5}\text{O}_4/\text{AC}$, $\text{NiFe}_2\text{O}_4/\text{AC}$), (B.4.6);
- Nano-sized zinc oxide (ZnO) (B.4.10);
- 5 % by weight of silver Al_2O_3 (B.4.9);
- Model $\text{NiMnO}_3/\text{Mn}_2\text{O}_3$ (B.4.8);
- Samples $\text{NiMnO}_3/\text{Mn}_2\text{O}_3$, $\text{NiMn}_2\text{O}_4/\text{NiMnO}_3/\text{Mn}_2\text{O}_3$ and $\text{Ni}_6\text{MnO}_8/\text{NiMnO}_3/\text{Mn}_2\text{O}_3$ (B.4.7);

- Nanocomposite powder from TiO₂-CeO₂-ZnO when mixing TiO₂, CeO₂ and ZnO in a mass ratio of 1:1:1, (B.4.11);

Chemical precipitation in combination with mechanochemical activation and/or heat treatment or mechanochemical activation in combination with microwave treatment has been used as fusion approaches. The experiments were carried out in varying the conditions of conduct of the mechanochemical activation: grinding speed from 200 rpm to 500 rpm, weight sample ratio: balls= from 1:6 to 1:46 depending on the type of material, grinding time in a wide range of 15 minutes to 330 minutes, temperature modes – in isothermic and dynamic heating conditions in an inert or oxidative gas medium.

Modifying the conditions of hard-phase synthesis by combining different approaches is a methodological development of synthesis methods and in particular of specifically used techniques such as mechanochemical and thermal activation. The variation of conditions allows for a significant improvement of conditions and optimization of resources, materials and time for conducting the experiments. The knowledge in the approaches used is applied to different systems, widely presented in the works of Zaharieva.

The focus of the candidate's developments are:

- Examination of the effect of the conditions of preparation on the physicochemical properties of synthesized materials;
- Monitoring the influence of the concentration of the test metals on the degree of application of metal ions in the structure of the synthesized materials depending on the methods and conditions used;
- Identification of correlations of the type, composition and structure of the materials examined, use and implementation of various chemical elements such as additives for the synthesis of oxide nanomaterials with modified properties;
- Identification of the influence of activation methods and the technological combined effect on the phase formation of the resulting nanocomposites, the dispersion and deflection of the structure in the study of their effect on the reactivity and properties of the new materials obtained.

For the purposes of the studies, numerous structural methods have been used to characterize the composition and properties of the resulting composite materials, such as X-ray analysis, Infrared spectroscopy, Thermal analysis, Mössbauer spectroscopy, determination of textural characteristics in cooperation with researchers from IC-BAS, the University of Salamanca, IP-BAS, IEES-BAS, IMC-BAS.

The main scientific contributions from the studies carried out are:

- synthesizing nano-sized composites at lower temperatures due to the higher reactivity and contact surface of the starting materials and establishing the influence of the synthesis method on the structure and morphology of materials, superparamagnetic behavior of synthesized ferrite materials;
- preparation of compositions with varying degrees of application of metal ions in the magnetite type structure with high dispersion, greater specific surface, and better photocatalytic activity to the degradation of Malachite green, Reactive black 5, Methylene blue, Methyl orange in aqueous solutions under the action of UV light compared to materials that are not mechanochemically processed;
- demonstration of the possibility of obtaining photocatalytic active materials - nanocomposites - TiO₂-CeO₂-ZnO, TiO₂-ZnO and TiO₂-CeO₂ by administration of mechanochemical activation as an appropriate method.

The candidate's personal contribution to the publications included in the Habilitation Author's Report is related to the conduct of material synthesizes by applying

the different techniques, processing the results obtained, determining important characteristics of the materials, such as the average size of the crystals, the parameter of the elementary cell and the degree of defection, participation in the interpretation of photocatalytic results, composition of publications and participation in the process of their issuance as a corresponding author. The results obtained present the materials studied with potential for use in ecology as photocatalysts for the degradation of organic pollutants in the environment.

4.2. *The Author's Report on the* on the publications under Indicator "Г" of Assistant Professor Katerina Lyubomirova Zaharieva PhD outside the habilitation work on the indicators in category "Г" summarizes the contributions from 21 publications (with №№ 1 (Г.7.21), 3 (Г.7.15), 6 (Г.7.9), 17 (Г.7.16), 21 (Г.7.17), 31 (Г.7.14), 32 (Г.7.11), 35 (Г.7.10), 39 (Г.7.18), 40 (Г.7.19), 41 (Г.7.7), 42 (Г.7.12), 43 (Г.7.13), 44 (Г.7.20), 46 (Г.7.6), 48 (Г.7.8), 50 (Г.7.2), 51 (Г.7.5), 52 (Г.7.1), 53 (Г.7.3), 54 (Г.7.4)), according to their numbering in the list of scientific publications. Additional publications (№№ 2, 4, 5, 10 and 14) have also been added to this group of publications, which, although thematically and methodically related to the publications in the Author's Report, do not cover the requirements of the Law on the Development of Academic Staff in the Republic of Bulgaria and the Rules for the terms and conditions for acquiring scientific degrees and for holding academic positions in the Bulgarian Academy of Sciences / Rules of Procedure for acquiring scientific degrees and for holding academic positions at IMC-BAS under the competition. The publications presented in category "Г" contribute from 304 points in mandatory defended – 220 point. From a reference from NACID for Assistant Professor K. Zaharieva (<https://ras.nacid.bg/dissertation-preview/37705>) it is evident that two of the articles with which Dr. Zaharieva defends the minimum requirements for ONS "Doctor" are also included in articles in category "Г". This articles Г.7.16 (№17) and Г.7.20 (№44), which protect 15 points and 12 points. I will not consider these articles. The publications presented in category "Г" have a contribution of 304 items according to the Author's report. After reduction by 27 points, 277 points are obtained (required 220).

According to the articles of this group, 25 citations were noted in the world databases WoS and Scopus.

The publications in the author's report outside the habilitation work are divided into 4 thematic directions:

1. Photocatalytic studies of $\text{NiO}_{0.8}\text{ZnO}_{0.2}/\text{ZnO}$, calcium titanium, phosphorus-dosed TiO_2 , abiotic, biogenic material, lepidoclite and hybrid nanocomposites (polybenzimidazole-ZnO, polydiphenylacetyl-ZnO in polystyrene matrix and ZnO/polystyrene) – covers publications №№ 42, 43, 46, 50-54;
2. Mechanochemical activation of zinc oxide without and dotted with Ag, Ni or Co, calcium titanium and magnetite-type materials (publications №№ 32, 35, 51);
3. Studies related to the phase composition and/or structure of photocatalysts and other materials (publications №№ 39, 40);
4. Synthesis of ferrite catalytic nanomaterials, nano-sized iron oxyhydroxides and composite photocatalysts based on nickel oxide and zinc oxide (publications №№ 3, 6, 21, 31, 41-43, 46, 48).

The research presented in this group of publications is accompanied by the same methodological approach – synthesis by precipitation, precipitation combined with thermal treatment, mechanical/thermal activation of materials and subsequent structural and photocatalytic characterization of the resulting or modified oxide materials and

composites with application as photocatalysts. For the study of structural properties, the same analytical methods described in the Habilitation Report of Zaharieva have been used, namely - radiophysical analysis, infrared spectroscopy, thermogravimetric analysis, photocatalytic tests.

The scientific contributions to the publications of the Author's Report can be summarized in the following areas:

In the study, photocatalytic activity in many publications looked at various oxide and composite materials - $\text{NiO}_{0.8}\text{ZnO}_{0.2}/\text{ZnO}$, calcium titanate, phosphorus-doped TiO_2 , lepidococitis, abiotic and biogenic material, hybrid nanocomposites of m-PBI/ ZnO (polybenzimidazole- ZnO , polydiphenylacetyl- ZnO nanocomposites without and in polystyrene matrix form and $\text{ZnO}/\text{polystyrene}$), and a higher degree of photocatalytic degradation of Malachite green, methylene blue and Methyl orange in aqueous solution under the action of UV light is demonstrated, depending on the approaches to their synthesis, thermal treatment temperatures, influence of precursors on the resulting materials. Characteristic parameters of photocatalysis are analyzed in detail - adsorption capacities, reaction speed constants and degree of degradation.

The influence of mechanochemical activation parameters, including rotational speeds, has been established, weight ratio of the specimen to the grinding bodies, duration of activation, etc. on photocatalytic activity in a number of materials, such as zinc oxide without and doped with Ag, Ni or Co (ZnO , Ag/ZnO , Ni/ZnO , Co/ZnO), calcium titanium and Ni substituted magnetite-type materials - $\text{Ni}^{2+}_{0.5}\text{Fe}^{2+}_{0.5}\text{Fe}^{3+}_2\text{O}_4$. As a result of the applied impact, a decrease in the average size of crystals, an improvement in photocatalytic activity with the potential for application as heterogeneous catalysts for the purification of water from organic pollutants is demonstrated.

The phase composition of materials from ZnO has been studied and doped with 1.5 wt. % lanthan ZnO , heat treated at 350°C, 450°C and 500 °C, as well as ZnO , doped by 1.5 w/w. % Ag, hardened at 500°C, as well as $\text{CoO}/\text{Al}_2\text{O}_3$, $\text{CuO}/\text{Al}_2\text{O}_3$, $\text{NiO}/\text{Al}_2\text{O}_3$ photocatalysts used to break down Malachite Green Dye under UV light. Phase formation with identification of La/ZrO_2 , $\text{Zn}_5(\text{NO}_3)_2(\text{OH})_8 \cdot 2\text{H}_2\text{O}$ and $\text{Zn}_5(\text{OH})_8\text{Cl}_2 \cdot \text{H}_2\text{O}$ has been demonstrated depending on the precursors used and high photodegradation of acid-impregnated Pho/ZnO azogrids.

A series of ferrite catalytic nanomaterials $\text{Ni}_x\text{Fe}_{3-x}\text{O}_4$ have been obtained, $\text{Mg}_x\text{Fe}_{3-x}\text{O}_4$ and $\text{Co}_x\text{Fe}_{3-x}\text{O}_4$ ($x=0.25, 0.5, 1$), ferrite/activated charcoal composite photocatalysts - $\text{M}_x\text{Fe}_{3-x}\text{O}_4/\text{activated carbon}$, $\text{M}=\text{Mn}, \text{Cu}, \text{Co}$, $x=0.5$ by precipitation followed by hardening. The effect of different metal ions on the photocatalytic activity of composites has been established.

The personal contribution of the candidate to the publications included in the Author's Report outside the habilitation work is again related to the conduct of the synthesis of materials by applying the different techniques, planning and conducting the mechanochemical activation under different conditions, processing of the results obtained, the interpretation of the results on the influence of mechanochemical activation on photocatalyst ability, infrared spectroscopy, composition of publications.

5. Critical notes and recommendations.

After consideration with the materials of the Assistant Professor Katerina Lyubomirova Zaharieva PhD, I could make some remarks to the candidate. For the competition, it presents a large number of publications, which it distributes in category "B" and "T". It remained unclear to me how the distribution was made, as interconnected publications are divided into the two categories, the numbering used is inconsistent and

confusing. Some articles show duplication of the same results (e.g. publications №15 and №21). It is noticed that the candidate's work is published mainly in journals with a low impact factor. Although they cover a large volume of work, the emphasis in them are oxide materials with photocatalytic activity. My recommendation to Assistant Professor Katerina Lyubomirova Zaharieva PhD is in her future research to focus efforts in refining and summarizing the results of the studies conducted and to orient her themes to the profile of IMC-BAS.

6. Conclusion.

Presented by Assistant Professor Katerina Lyubomirova Zaharieva PhD documentation for participation in the competition covers the requirements the Law on the Development of Academic Staff in the Republic of Bulgaria and the Rules for the terms and conditions for acquiring scientific degrees and for holding academic positions in the Bulgarian Academy of Sciences / Rules of Procedure for acquiring scientific degrees and for holding academic positions at IMC-BAS under the competition and correspond to the theme of the announced competition for academic position "Associate Professor". The evidence is the material cover 657 points and exceeds the minimum requirements of the normative documents. I appreciate the materials presented in the competition and recommend to the Scientific Jury to propose to the Scientific Council of IMC-BAS the candidate Assistant Professor Katerina Lyubomirova Zaharieva PhD to be elected to the academic position "Associate Professor" at IMC-BAS in professional field 4.2. Chemical Sciences ("Solid State Chemistry, Nanoscale Materials and Minerals") for the needs of the department "Structural Crystallography and Material Science" at IMC-BAS.

Sofia

22.04.2021

Reviewer:

(prof. eng. V. Petkova PhD)