

REVIEW

on the competition for the academic position "**Professor**"
in the professional field 4.2. Chemical sciences (Inorganic chemistry),
announced in the **State Gazette no. 96/19.11.2021**
by Sofia University "St. Kliment Ohridski"
for the Faculty of Chemistry and Pharmacy

Reviewer: Prof. Dr. Ekaterina Zhecheva from the Institute of General and Inorganic Chemistry of the Bulgarian Academy of Sciences

By order of the Rector of Sofia University "St. Kliment Ohridski" (SU) N RD-606/14.12.2021 I was appointed to be a member of the Scientific Jury announced by SU in SG No. 96/19.11.2021 for selection of a Professor in Professional Field 4.2 Chemical Sciences (Inorganic Chemistry). The only applicant is Associate Professor Dr. Penka Vasileva Tsanova from the Department of Inorganic Chemistry at the Faculty of Chemistry and Pharmacy of SU. The submitted materials are in accordance with the Act on Development of the Academic Staff in the Republic of Bulgaria (ADASRB), the Regulations for the application of the ADASRB, the Regulations for the terms and conditions for acquiring academic degrees and occupying academic positions at the Sofia University "St. Kliment Ohridski" and the Recommendations on the criteria for acquiring scientific degrees and occupying academic positions at the Sofia University for the professional field "Chemical Sciences", related to the procedure for occupying the academic position "Professor".

Brief Biography of the Applicant

Associate Professor Dr. Penka Vasileva graduated in the year 1981 from the Faculty of Chemistry of Sofia University "St. Kliment Ohridski" as a Magister in Chemistry, majoring in Inorganic Chemistry. Her magister thesis is entitled "Catalytic oxidation of CO on supported silver catalysts". The entire research activity of Mrs. Vasileva takes place at the Faculty of Chemistry of SU, currently Faculty of Chemistry and Pharmacy (FChPh). During 1984-1987 she was a PhD student and, after that, she worked as a chemist at the Laboratory of High Purity Substances at FChPh-SU. Since 1989 she is an Assistant Professor at the Department of General and Inorganic Chemistry. In 2003 she defended a PhD Thesis entitled "Synthesis of silicon tetrachloride and rectification purification of silicon tetrachloride and some organic solvents". In 2012 she was selected as an Associate Professor in Inorganic Chemistry at the Department of Inorganic Chemistry at FChPH. The scientific interests of Assoc. Prof. Vasileva are mainly in the field of inorganic chemistry and namely preparation of high purity- and special purity substances as well as synthesis and properties of nanomaterials and nanocomposites.

Description of the Submitted Documents

Assoc. Prof. Vasileva presented a list of her total scientific output: 66 scientific papers published in journals, book chapters and conference proceedings, 33 of which are in quartiles journals. Fifteen papers are related to chemical education or to the International Chemistry

Olympiad. She is also co-author of 14 schoolbooks and manuals, 6 technologies and has participated in 82 scientific forums (52 international and 30 national). A total of 401 independent citations have been noticed on her entire scientific output (Scopus, 7.12.2021) that determine Hirsch factor of 9 (without self-citations).

The candidate participates in the competition for Professor in Inorganic Chemistry with 16 scientific papers in specialized journals that are referred in Scopus and/or WoS (A1-A16) and 3 book-chapters published abroad (B34-B36). The papers are distributed in quartiles journals (Q) as follows: 6 papers in Q1 journals, 2 papers in Q2 journals, 4 papers in Q3 journals, 1 paper in a Q4 journal, 1 paper with SJR. Two papers are in journals that are not presented in Scopus and/or WoS but they are cited in Scopus as a secondary source (A10, A15). The last papers, according to the Recommendations on the criteria for acquiring scientific degrees and occupying academic positions at the Sofia University for the professional field "Chemical Sciences", equate to papers that are referred in Scopus and/or WoS. In addition, the candidate has presented 2 papers that are published in a referred in Chemical Abstract scientific journal (D52-53) and a paper published in a conference proceeding (D54). Among them are the respectable scientific journals Carbohydrate Polymers (IF₂₀₁₆=4.811), Molecules (IF₂₀₂₁=4.412), Analyst (IF₂₀₁₆=4.107), Journal of Analytical Atomic Spectrometry (IF₂₀₁₆=3.379), Microchemical Journal (IF₂₀₁₆=3.034), etc. Five publications are included in the Habilitation work (3 in Q1 journals, 1 in a Q3 journal and 1 with SJR).

A part of the scientific output of Assoc. Prof. Dr. Vasileva for the competition is in the field of Chemical education. The candidate has presented 3 papers (C37-C39) that are related to the International Chemistry Olympiad and published in the referred in Scopus scientific journal Science (2 papers with Q3 and 1 with Q4). A list with 11 published and approved by the Ministry of Education textbooks and manuals for the secondary school is also presented.

According to the candidate, 153 citations are noted on the publications for the competition. After the habilitation in 2012, the number of citation on all publications of Assoc. Prof. Dr. Vasileva is 374 (Scopus). The results of her research during 2013-2021 were presented at 37 scientific forums (31 international).

For the period she was team-leader of 6 research projects of the Science Fund of SU and a Bulgarian company and team-member of 8 projects funded by the European Commission, Operation programs, National Science Fund and Ministry of Education.

Information on the pedagogical activity of the candidate is included in the documents: lectures and practices, teaching load, supervision of graduate- and PhD students.

A check-up is presented for the compliance of the scientific asset of the applicant with the National Minimal Requirements and the Recommendations on the criteria for acquiring scientific degrees and occupying academic positions at the Sofia University for the professional field "Chemical Sciences". Scientometric data of Assoc. Prof. Penka Vasileva fulfil the requirements for occupying the academic position "Professor".

General Characteristics of the Research Activity

The major part of the scientific papers of Assoc. Prof. Vasileva presented for the competition are devoted to the chemistry of nanomaterials. They are thematically related and comprise studies on the synthesis of metal nanoparticles and nanocomposites and their

application in analytical chemistry for speciation and multi-element analysis, as biological agents, catalysts and photocatalysts. The habilitation work is entitled “Design and characterization of new nanomaterials for speciation analysis of mercury, chromium and iron”. In this work, synthesis methods of starch- and raffinose-capped mono- and bi-metal silver and gold nanoparticles in water dispersions is reported. Special attention is paid on the optimization of the synthesis procedures in terms of nanoparticles size and shape. Results on the immobilization of the nanoparticles on silica sub-micro spheres forming “core-shell” nanocomposites and the preparation of hybrid organic-inorganic composites with chitosan and polyvinyl alcohol are provided. The application of these “intelligent” nanomaterials as sensors and sorbents for selective separation and/or quantitative determination of the high toxic or bioavailable chemical forms of mercury, chromium and iron is demonstrated. The habilitation work is written on 89 pages and contains, apart from the results published in papers NN A1, A3, A4, A7 и A12, some additional research. This gives a complete and comprehensive look to the habilitation work that could serve as the basis for a future monographic work. There are 44 citations on the publications included in the habilitation works, but it should be noted that only two of the publications from the habilitation work were published before 2019.

Most of the papers beyond the habilitation work also consider the preparation and the different application of silver and gold nanomaterials. Paper D52 displays systematic studies on the environmentally friendly synthesis of silver nanoparticles using mono- and disaccharides. Papers A6 and A15 are closely related to the habilitation work and contain results on the elaboration of optical sensors for Hg^{2+} detection using silver nanoparticles and on the extraction effectiveness of sorbents based on silica-immobilized silver and gold nanoparticles towards chemical species of mercury. The application of silver and gold nanocomposite hybrid films in multi-element analysis using solid-state extraction of cations is displayed in papers A9 and A11. Some aspects of the biological activity of silver nanoparticles, and namely their toxicity and impact on the cordial activity, are outlined in papers A13 and A14. Catalytic and photocatalytic properties of nanomaterials are also studied. Thus, golden nanoparticles are applied as a pseudo-homogenous reduction catalyst for a model dye (D54). A method is elaborated for the synthesis in a starch matrix of nanocrystal ZnO and composite nanocrystals of Au/ZnO that display photocatalytic activity (papers A2, A10, D53). In paper A5, the research on new nanosorbents went ahead with the synthesis of new sorbents based on Cr(VI) imprinted methylimidazolium ion liquids and their application for fast and selective determination of Cr(VI).

The materials for the competition contain also 4 review papers on the functional properties of nanomaterials. The book-chapter B34 summarizes author’s research on raffinose-stabilized silver nanoparticles as selective and sensitive optical sensors/sorbents for speciation analysis of Cr in water samples. The paper A6 and the book chapter B35 offer reviews on the application of “intelligent” nanomaterials and nanocomposites for speciation analysis. B36 reviews the importance of nanoparticles and nanostructures as antibacterial agents.

Major scientific contributions

Scientific contributions concerning the target synthesis of new nanomaterials and their application in modern analytical practice are most outlined in the research studies of Assoc. Prof. Vasileva. The most important are as follows:

New synthesis procedures for of nanomaterials

- Methods for synthesis of monodisperse silver and gold nanoparticles capped with starch or raffinose. The methods are well reproducible, environmental friendly and provides stable nanoparticles in water dispersions.
- New synthesis procedure of “core-shell”-type nanocomposite materials ($\text{SiO}_2\text{-NH}_2\text{@AgNPs}$ и $\text{SiO}_2\text{-NH}_2\text{@AuNPs}$), consisting of surface modified submicron SiO_2 spheres decorated by homogeneously located on its surface silver and gold nanoparticles.
- Environmentally friendly method for the preparation of hybrid nanocomposite films with a homogeneous structure, high stability and mechanical strength by incorporation of raffinose capped silver nanoparticles in the polymer matrices chitosan (CS) and polyvinyl alcohol (PVA).
- Synthesis procedure of a new hybrid organic-inorganic “core-shell” composite material based on a Cr(VI) imprinted ion liquid on micron-sized SiO_2 ($\mu\text{SiO}_2\text{@Cr(VI)-IIL}$).

The relationships between synthesis conditions, physico-chemical characteristics and functional properties of the nanomaterials have been elucidated.

New nanosensors and nanosorbents for speciation and multielement analysis

The analytical characteristics of the nanomaterials as optical sensors and nanosorbents for solid state extraction are studied and their analytical applicability is evaluated.

- It was shown that the sensor activity of starch capped silver nanoparticles is selective towards Fe(III) in the presence of Fe(II) as well as towards Hg(II) in the presence of CH_3Hg^+ . A LSPR-based optical sensor is proposed. Simplified and fast analytical procedures for Hg(II) and Fe(III) screening in ground water and drinking water and for determination of Hg in waste water were developed.
- A new methodology for direct and selective determination of Cr(VI) in water samples is elaborated, according to which raffinose capped silver nanoparticles are used as a LSPR optical sensor. The methodology enables accurate and reliable Cr(VI) determination in the presence of a high Cr(III) concentration and can be used for Cr(VI) monitoring procedures in accordance with the national and European legislation.
- A different behavior of the metal-oxide nanocomposites $\text{SiO}_2\text{-NH}_2\text{@AgNPs}$ and $\text{SiO}_2\text{-NH}_2\text{@AuNPs}$ towards Hg(II) and CH_3Hg^+ is demonstrated that enables their use for Hg speciation analysis in water samples. A validated analytical procedure for enrichment and quantitative determination of inorganic Hg in surface water is developed as well as an easy analytical procedure for speciation analysis of Hg in tap water.
- It was shown that nanocomposites based on chitosan/raffinose stabilized nanoparticles CS-Ag/Raff NPs are effective sorbents for multielement solid state extraction and enrichment of a great number of microelements such as Al(III), Cd(II), Co(II), Cu(II), Fe(III), Ni(II), Pb(II) and Zn(II). An analytical method for determination of these elements in surface water is elaborated as well as a validated analytical procedure for determination of Al(III), Cd(II) and Pb(II) in hemodialysis solutions with detection limits that satisfies the standards of the European pharmacopoeia.

- The hybrid nanocomposite films CS-AgNPs/Raff are applied as an effective and selective sorbent for Cr(VI) in the presence of Cr(III). An analytical method is proposed that meets the technical requirements of the programs for monitoring of surface water quality.
- Hybrid organic-inorganic micron-sized SiO₂ spheres with a surface layer of Cr(VI) imprinted methylimidazolium ion liquid $\mu\text{SiO}_2\text{@Cr(VI)-IIL}$ are demonstrated to be effective sorbents for fast and selective quantitative determination of Cr(VI) in factory fabrics. A validated analytical procedure for determination of Cr(VI) is elaborated that meets the international standards.

The summary of the contributions made by Assoc. Prof. Dr. P. Vasileva is detailed and correct and proves that her personal input is undisputable and significant. The main impression is that extended and precise experimental studies are done. The research is complex, combining original synthesis procedures of nanomaterials with their real application as new tools for analytical control - a topical problem of growing interest during last years. The contributions are both fundamental and applied and can be considered as novelty in science and knowledge enrichment.

I would like to emphasize once more the complex nature of research of Assoc. Prof. Dr. P. Vasileva. Her useful collaborations with colleagues from the Department of Analytical Chemistry of FChPh – SU, the Biological Faculty of SU and the Faculty of Pharmacy of Medical University – Plovdiv have also contributed to the complexity of the studies.

Pedagogical activity

Assoc. Prof. Vasileva has an active teaching and pedagogical activity. After the habilitation in 2012 she was lecturer of 8 courses in inorganic chemistry that are compulsory for bachelor students from various specialties and of the compulsory course “Special chemicals – preparation and purification” for a master’s program. Her current teaching load is 368 hours. Assoc. Prof. Vasileva cooperates well with students and PhD students. In 13 papers submitted for the competition she has students and PhD students as co-authors and during 2013/2021 she was supervisor/co-supervisor of 7 Diploma theses and 1 PhD thesis.

The candidate also has important contributions to the development of school education in chemistry. She was the co-leader of the Bulgarian National team for the International Chemistry Olympiad and a member of the International jury. She is a member of the National Commission for the organization of the National Chemistry and Environment Olympiad and is co-author of 4 collections of original chemistry problems. She is co-authors of 3 textbooks and 4 manuals in chemistry and environmental protection that are approved by the Ministry of Education for the secondary school. All this reflects significant contribution of Assoc. Prof. Vasileva to the of chemistry education.

Critical notes and recommendations

I have no general objections and recommendations to the research work of Assoc. Prof. Vasileva.

Conclusion

The documents and materials that are submitted by Associate Professor Dr. Penka Vasileva for the competition fulfill the requirements for occupying the academic position of Professor at Sofia University “St. Kliment Ohridski” in the professional field 4.2.Chemical

Sciences. The candidate has carried out complex and in-depth research in significant and modern topics, focusing on both fundamental and applied problems. The scientific publications of Assoc. Prof. Vasileva contain a large amount of new results and are subject of many citations. It is evident that the candidate is a prominent expert in the field of nanoscience and nanotechnology who has an individual approach and is able to lead important research studies. She combines successfully research and pedagogical activity. All this gives me reason strongly to recommend Associate Professor Dr. Penka Vasileva to occupy the academic position of "Professor" in the professional field 4.2. Chemical sciences (Inorganic Chemistry) at the Faculty of Chemistry and Pharmacy – SU.

Reviewer:

Prof. Dr. Ekaterina Zhecheva

Sofia, 14.03.2022