

REVIEW

on the competition for the occupation of the academic post “Professor”

in the sphere of higher education 4. Natural Sciences, Mathematics and Informatics, professional field 4.3. Biological Sciences, specialty 01.06.08 “Biophysics” according to the announcement in the SG№41 / 21.05.2019

with the candidate Sashka Boychova Krumova, PhD, Associate Professor in the section “Biomacromolecules and Biomolecular Interactions” at the Institute of Biophysics and Biomedical Engineering at BAS (IBPhBME-BAS)

by the reviewer Miroslava Konstantinova Zhiponova, PhD, Associate Professor in the Department of Plant Physiology, Faculty of Biology, Sofia University “St. Kliment Ohridski” (FB-SU)

1. General information on the career and thematic development of the applicant.

Sashka Krumova holds a Master's Degree in Biotechnology from FB-SU with a specialization in “Molecule Biotechnology”, after which she continues her education through a bilateral cooperation between the Institute of Biophysics (now IBPhBME) and the Institute of Plant Biology at the Szeged Biological Research Center of the Hungarian Academy of Sciences. During the preparation of her dissertation, Sashka Krumova acquired serious professional skills in the field of biophysics, photosynthesis, absorption and fluorescence spectroscopy, electro-optics, differential scanning calorimetry and circular dichroism. As a result, in 2006, she received her educational and scientific degree (ESD) “doctor” with a dissertation theme: *“Temperature stability of pigment-protein complexes in thylakoid membranes of higher plants. Thermo-optical effect”*. In addition, she has completed international advanced training courses related to: biophysics of lipid-protein interactions, organization of biological membranes, photosynthesis, spectroscopic methods, electron-spin resonance, computational methods in chemistry and fluorescence spectroscopy, microspectroscopy, as well as course for schedule management, project planning and teamwork.

In the period 2005-2007, Dr. Sashka Krumova was appointed as a specialist at the Institute of Plant Biology in Szeged, where she continued her experimental work in the field of biophysics. In 2008-2009, she completed her postdoctoral specialization at the University of Wageningen in the Netherlands that is also in the field of biophysics. Since 2009, she has been appointed to the IBPhBME initially as a specialist and then as a Senior Assistant conducting research with leadership and participation in scientific and educational projects. Since 2013, Dr. Krumova has held the academic post of Associate Professor continuing her work at the

IBPhBME in the section “Biomacromolecules and Biomolecular Interactions”. Since March 2019, Assoc. Prof. Dr. Krumova has been the Scientific Secretary of the IBPhBME.

In conclusion, Assoc. Prof. Sashka Krumova shows a deep research interest and experience in the field of biophysics. She is also a long-time member of the section "Biomacromolecules and Biomolecular Interactions", which makes her a suitable candidate for the declared post.

2. General description of the presented materials.

The submitted materials include the necessary administrative documents to certify: acquired ESD “doctor”, occupation of the academic post "Associate Professor", work experience in the specialty, as well as an announcement in the State Gazette №41/21.05.2019. A detailed reference is made to the fulfillment of the minimum national requirements for occupying the academic post "Professor", as well as the specific requirements specified in Annexes 1 and 2 of the Regulation for the implementation of the Law on the Development of the Academic Staff in the Republic of Bulgaria (LDASRB or ZRASRB) in IBPhBME. Regarding the research activity, materials are included such as the curriculum vitae and the lists of publications presenting the participation of Assoc. Prof. Sashka Krumova for the acquisition of ESD “doctor”, for the occupation of the academic post of Associate Professor and for the competition for occupation of the academic post “Professor”. Provided are the dissertation summary for the acquisition of ESD “doctor” and the abstracts (in Bulgarian and English) and copies of the scientific publications used for this competition. A detailed author's habilitation reference for scientific contributions is present. A copy of the Regulation for the implementation of the LDASRB (or ZRASRB) in IBPhBME is also included. In conclusion, Assoc. Prof. Dr. Sashka Krumova participates in the competition with all the necessary materials which are presented in both paper and electronic form.

3. Publications before and after the academic degree.

The total number of scientific publications of Assoc. Prof. Krumova included in the reference for the fulfillment of the minimum national requirements for occupying the academic post “Professor” is **38**. **The dissertation summary and 3** of the scientific publications are included in the PhD work. On the basis of a PhD thesis for the award of the ESD “doctor” at the University of Wageningen, Assoc. Prof. Dr. Krumova has also published **1** book. The publications used for the competition for occupation of the academic post “Associate Professor” are **12**. In the present competition for the academic post "Professor", a total of **21** scientific publications (all officially published) by Assoc. Prof. Dr. Krumova have been submitted for

participation, which do not repeat the ones submitted for acquisition of the ESD “doctor” and for the occupation of the post “Associate Professor”, and respectively these are subject to review. From these 21 publications, 8 are used for the rehabilitation work on the topic: *"Calorimetric markers for the detection and monitoring of patients diagnosed with multiple myeloma"*. The other 13 publications are out of the main habilitation topic. In conclusion, the candidate's scientific output of **38 publications** meets the national minimum requirements for occupying the academic post “Professor”. In addition, a reference at <https://orcid.org/0000-0001-7412-8398> shows **over 50 scientific papers** in which Assoc. Prof. Dr. Sashka Krumova has contribution.

4. Pedagogical activity.

Assoc. Prof. Dr. Sashka Krumova has one student that successfully defended Ph.D work.

5. Basic scientific and applied contributions.

Assoc. Prof. Dr. Sashka Krumova focused her habilitation work on the direction: *"Calorimetric markers for detection and monitoring of patients diagnosed with multiple myeloma"* (Todanova et al. 2014, 2016, 2018a, b; Krumova et al. 2015, 2017; Danailova et al. 2017). In the last 10 years, Assoc. Prof. Dr. Krumova's research team has emerged as a pioneer in the application of the thermodynamic approach in medicine, the establishment of specific calorimetric markers and its validation in clinical practice. Assoc. Prof. Dr. Krumova and her colleagues presented a detailed analysis of the calorimetric characteristics of blood serum from patients with various types of multiple myeloma and macroglobulinemia at Waldenstrom. General and specific calorimetric markers have been established to identify different forms of the disease, as well as to distinguish it from other hematologic and cancerous diseases. In a further study, a higher sensitivity of the calorimetric approach was demonstrated compared to an alternative fluorescence method (Danailova et al. 2015). These original fundamental studies are highly applied in clinical practice, and can be used both to detect the disease and to track the success of the rehabilitation therapies applied.

In parallel, Assoc. Prof. Dr. Krumova continues her work on a direction already developed by her and in her group, related to the study of the structural stability of pigment-protein complexes building up the photosynthetic apparatus of higher plants and cyanobacteria (Andreeva et al. 2014, 2015; Dobrikova et al. 2014; Krumova et al. 2014; Sotichev et al. 2015; Petrova et al. 2018a, b, c; Danova et al. 2017). The studies investigate the regulation of the photosynthetic activity by the structural organization of the complexes and the effects of different classes of phytohormones. These basic studies have potential applications to optimize

the process of photosynthesis in higher plants and cyanobacteria under adverse climatic conditions, as well as to develop improved sources of biomass and fuels.

The third direction in which Assoc. Prof. Dr. Krumova works is exploring of the calorimetric approach potential for diagnosis of other diseases based on thermodynamic properties. The application of the method for discriminating against schizophrenia and for providing valuable information on the effect of the administered treatment is confirmed (Krumova et al. 2013). The research team of Assoc. Prof. Dr. Krumova, for the first time established specific calorimetric characteristics of cancer cells that differentiate them from normal cells (Todinova et al. 2016b). In summary, the input of this scientific work contributes to the identification of additional biophysical characteristics with diagnostic potential.

The fourth research area of Assoc. Prof. Dr. Krumova is related to the characterization of various factors for the stabilization and destabilization of the proteins thymidylate synthetase and hemoglobin. The results regarding the energetics of the differentiated interaction between factors and bacterial thymidylate synthetases are original (Krumova et al. 2016). The obtained information is valuable in terms of the development of new pharmaceutical products such as antimicrobial agents. Assoc. Prof. Dr. Krumova, along with other researchers, have succeeded in applying the thermodynamic approach in conjunction with other methods to track the aging process of erythrocytes (Dinarelli et al. 2017). These results allow to trace the potential link between erythrocyte aging and a number of pathologies, as well as to develop protocols for the storage of blood and blood products.

The major contributions from the research activities of Assoc. Prof. Dr. Krumova provide clear and well-systematized information on the scientific work carried out. I am convinced that these contributions are significant and provide opportunities for continuing the research on this topic, as well as for applying the gained experience in new basic and applied research jointly with the staff of the “Biomacromolecules and Biomolecular Interactions” section at IBPhBME, as well as with other scientific groups.

6. Reflection of the candidate's scientific publications in national and foreign literature.

Out of the **21** scientific publications under revision for the present competition, **18** are in journals with impact factor (total **IF 51.4**) and **1** is in a refereed journal (with **SJR 0.23**). The total impact index is **51.63**. The publications are mainly in reputable high-rank international journals: Analytical Chemistry /IF:5.636/; Biochimica et Biophysica Acta - General Subjects /IF:3.679/; Biophysical Journal /IF:3.632/; Colloids and Surfaces A: Physicochemical and Engineering Aspects /IF:2.752/; European Biophysics Journal with Biophysics Letters

/IF:1.472/; International Journal of Biological Macromolecules /IF:3.671/; Journal of Bioenergetics and Biomembranes /IF:2.914/; Journal of Molecular Recognition /IF:1.868/; Journal of Photochemistry and Photobiology B /IF:2.96/; Journal of Plant Growth Regulation /IF:2.073/; Langmuir /IF:3.993/; Photosynthesis Research /IF:3.091/; Plant Physiology and Biochemistry /IF:2.756/; Thermochemica Acta /IF: 2.189/.

The number of observed citations of the scientific publications of Assoc. Prof. Dr. Krumova after occupying the post of “Associate Professor” exceeds **135** according to Web of Science and Scopus (for reference, the total number of citations according to Scopus are **over 300**). The scientific works are cited mainly by foreign authors but there are also citations by Bulgarian scientists, as the citations being mostly in reputable international editions. In conclusion, the scientometric indicators of the scientific production of Assoc. Prof. Dr. Krumova are extremely high and confirm the importance of the research for the national and international scientific community, and their number and quality fully satisfy the requirements for acquiring the academic post “Professor”.

7. Applicant's contribution to collective publications.

The publications submitted for the competition are with authors' teams with scientists from IBPhBME and other institutes of BAS (Institute of Biology and Immunology of Reproduction, Institute of Biodiversity and Ecosystem Research, Institute of Experimental Morphology and Anthropology with Museum, Institute of Information and Communication Technologies, Institute of Molecular Biology, Institute of Organic Chemistry with Centre of Phytochemistry, Institute of Plant Physiology and Genetics), National Specialized Hospital for Active Treating of Haematological Diseases in Sofia, University of Burgas, Medical University of Sofia, Sofia University, as well as with foreign research groups (from Spain, Italy, Hungary, France, Czech Republic, Switzerland). From the 21 publications reviewed in the competition, Assoc. Prof. Dr. Krumova is the first author of 5 and the corresponding author of 4. In conclusion, Assoc. Prof. Dr. Krumova's contribution to collective publications is significant and determines her ability to lead successfully research in national and international teams.

8. Demonstrated research leadership skills or capabilities.

The total number of Assoc. Prof. Dr. Krumova's participations in projects included in the application for the fulfillment of the minimum national requirements for occupying the academic post “Professor”, is **19** (15 national and 4 international). She is the head of 2 projects, one of which is a project for young scientists funded by the Ministry of Education and Science of Bulgaria, and the other project is a bilateral agreement between BAS and a Hungarian

scientific organization. This active participation of Assoc. Prof. Dr. Krumova in the projects, together with the successful specializations abroad, demonstrate her ability to provide funding for research. As a result of the work from the utilized funds, quality publications are produced annually with various national and international teams, which respectively help to improve the recognition of IBPhBME and BAS. My conclusion is that Assoc. Prof. Dr. Krumova maintains and exploits effectively the established contacts with research groups in the country and abroad, and she intensively develops new successful collaborations, which defines her as a good project manager.

9. Profile of the applicant's research work.

Assoc. Prof. Dr. Sashka Krumova has a clearly outlined profile in the field of biophysical characterization of biological objects. Accordingly, her work focuses on studying the relationship between structure and function at different levels of organization of biomacromolecules: *i.* in the photosynthetic apparatus of higher plants and cyanobacteria; *ii.* in erythrocytes; *iii.* in blood serum proteome in multiple myeloma and other pathologies; *iv.* in human cancer cell lines and nuclei isolated from them; *v.* bacterial enzymes.

The future research of Assoc. Prof. Dr. Sashka Krumova is planned to continue in the following main directions: *i.* application of nanotechnologies to optimize the growth, development and resistance to stress of higher plants; *ii.* exploring the potential of the nanotechnologies to develop biomedical technologies; *iii.* search for new biophysical approaches for the diagnosis of diseases by studying the mechanism of erythrocytes aging. In my consideration, the applicant's research profile is entirely in the area of the announced competition for the needs of the “Biomacromolecules and Biomolecular Interactions” section at IBPhBME.

10. Critical notes of the reviewer on submitted research work.

I have no critical notes on the submitted work material. I strongly recommend that Assoc. Prof. Dr. Krumova continues to attract young and motivated scientists to whom to transfer her extensive research experience.

11. Personal impressions about the applicant.

It is my belief that Assoc. Prof. Dr. Krumova is a responsible, hardworking and persistent researcher whose approach to scientific problems is characterized by focus and precision. It is impressive her passion to develop, both in the field of basic research and its practical application, which together with her ability to work with the team of the “Biomacromolecules and biomolecular interaction” section will create conditions for future successful and innovative

achievements. In addition, since 2019, Assoc. Prof. Dr. Krumova is also the scientific secretary of IBPhBME, which reflects her commitment to the development of the entire institute. In my opinion, Assoc. Prof. Dr. Sashka Krumova is a scientist whose personal and professional qualities will continue to be useful for the development of the Bulgarian science.

12. Conclusion.

The thorough review of the scientific papers submitted for review, their fundamental and applied scientific contributions, their international relevance, as well as the project activity, outline the applicant as an established biophysics researcher. My conclusion is that the scientific production of Assoc. Prof. Dr. Krumova completely satisfies the recommended criteria of the LDASRB (or ZRASRB) and the Regulation for its implementation in IBPhBME for the occupation of the academic post “Professor”. Based on the made review, I strongly recommend to the Honorable Scientific Jury and the Scientific Council of IBPhBME to award the academic post “Professor” to Assoc. Prof. Dr. Sashka Boychova Krumova.

15.09.2019

Reviewer:

/Assoc. Prof. Miroslava Zhiponova, PhD/