

REVIEW

of the application, submitted for participation in the competition for the academic position of “Professor” in the Professional Field 4.1. Physical Sciences (Physics of Atoms and Molecules)

for the needs of the University of Sofia “St. Kliment Ohridski” (SU),
announced in the State Gazette, issue 24/17.03.2023.

The review is prepared by Prof. Valentin Nikolov Popov, D.Sc., Faculty of Physics (FP) of SU, in his capacity as a member of the Scientific Committee according to Order RD-38-174/ 20.04.2023 by the Rector of SU.

Assoc. Professor D.Sc. Stanislav Balushev Balushev, FP of SU, is the only candidate, who has submitted documents for participation in the announced competition.

I. General description of the submitted materials

1. Application data

The documents submitted for participation in the competition in accordance with Art. 117(2) of the “Regulations on the terms and conditions for obtaining scientific degrees and holding academic positions at Sofia University St. Kliment Ohridski” (ПУРПНСЗАДСУ) were provided to the Committee members in electronic format. The documents submitted for the competition by the candidate meet the requirements of ЗРАСРБ, ППЗРАСРБ and ПУРПНСЗАДСУ. In particular, the candidate participates in the competition with 25 publications in journals and one book chapter.

The submission includes also the obligatory tables for the FP from Appendix 2 of ПУРПНСЗАДСУ: Table for meeting the minimum requirements based on Table D.1 for required points by groups of indicators and Table D.2 for the number of points by indicators. Table D.3, containing a report on the compliance of the publications with the additional requirements of the FP, Table D.4, containing a report on the compliance of the citations with the additional requirements of the FP, as well as Table D.5 for compliance with the additional requirements of the FP are also presented.

2. Candidate data

The candidate graduated from the FP in 1990. In 1998, he was awarded the educational and scientific degree “Doctor of Physics” after defending a thesis titled “Phase Modulation of Light Beams. Dark Spatial Solitons”. In 2009, he was awarded the scientific degree “Doctor of Physical Sciences” (D.Sc.) after defending a thesis titled “Energy Transport in Optically-Created Densely-Populated Organic Triplet Ensembles”.

The candidate has worked consecutively as an Assistant Professor and Senior Assistant Professor at the Technical University of Sofia in the period 1991 - 2003. Since 2009, he has been working as an Associate Professor at the Department of Optics and Spectroscopy at the FP. Presently, he is the acting head of the Laboratory of Organic Optoelectronics.

The candidate has been doing postdoctoral research with a scholarship from DAAD in Germany, and as a visiting researcher in Germany and Israel, a Marie-Curie Fellow in Germany as well has been the head of a Group on Photo-physical Chemistry in Germany. He has participated in or managed more than 16 scientific projects with national or international funding.

3. General characteristics of the scientific achievements of the candidate

The candidate is involved in experimental scientific research in the field of photochemistry. His research interests cover tackling important scientific and applied problems with significant economic and societal effects. The candidate has been collaborating with world-renowned scientists from Germany, Austria and Israel, and has established a research group in this field in Germany. He reports the results of his research in a large number of publications in renowned editions; their significance is supported by a large number of citations. The quantitative indicators of the materials submitted for the competition are summarized in Table 1.

The materials submitted for the competition cover and in some cases even exceed the minimum requirements of ЗРАСБГ, ППЗРАСРБ и ПУРПНСЗАДСУ, as shown in Table 1.

Table 1. Implementation of the minimum requirements of ЗРАСРБ, ППЗРАСРБ, and ПУРПНСЗАДСУ (Tables D.1 and D.2).

Group of indicators	Indicators	Total points (required minimum total points by ЗРАСРБГ/FP)
A	1. Dissertation for the award of ONS “Doctor”	50 (50)
Б	2. Dissertation for the award of NS “Doctor of Sciences”	100 (0)

B	3. Habilitation work – monograph 4. Habilitation work – Scientific publication in editions that are referenced and indexed in world-famous databases of scientific information (Web of Science and Scopus)	0 (0) 4 publ. in Q1 x 25 0 publ. in Q2 x 20 0 publ. in Q3 x 15 = 100 (100/100)
Г	7. Scientific publication in editions that are referenced and indexed in world-famous databases of scientific information (Web of Science and Scopus) 8. Published book chapter or collective monography	15 publ. в Q1 x 25 6 publ. in Q2 x 20 0 publ. in other x 10 1 publ. 15 (15) = 510 (200/200)
Д	11. Citations in scientific editions, monographs, collective volumes and patents that are referenced and indexed in world-famous databases of scientific information (Web of Science and Scopus)	2 x 154 cit. = 308 (100/200)
E	12. Awarded scientific degree “Doctor of Sciences” 13. Supervision of defended PhD student 14. Participation in a national scientific or educational project 15. Participation in an international scientific or educational project 16. Management of a national scientific or educational project 18. Total amount of the projects’ budget managed by the candidate	75 (75) 50 (50/n) 4 projects (10) 2 projects (20) 5 projects (20) 200 (1 per 5000 bgn) = 505 (150/150)

Group of indicators	Indicator	Number (required minimum number)
Additional requirements of the FP	21. Supervision of defended PhD students	1 (1)
	23. Number of publications of group I in the previous 3 years	10 (1)
	24. Number of publications of group I in groups of indicators B and Г	25 (9)
	27. Number of publications of groups of indicators B and Г with essential contributions by the candidate	12 (6)
	28. h-index	28 (8)
	29. “Golden Publication”	7 (1)
	31. Teaching hours	1097 (810)

The presented scientific papers do not repeat those of previous procedures for acquiring a scientific title and an academic position. My opinion is that there is no plagiarism in the publications submitted for the present competition.

4. Characteristics and evaluation of the teaching activity of the candidate

The documents submitted for the competition show that in the previous five years, the candidate has taught students and his classroom activity has exceeded significantly the required minimum study load of 360 hours per year. He has supervised 5 successful diploma students and 4 PhD students out of which one has defended the thesis successfully. Moreover, the candidate is the head of the Laboratory of Organic Optoelectronics. These facts show the serious commitment of the candidate to the teaching activities at the FP.

5. Analysis of the scientific and scientific-applied achievements of the candidate contained in the materials for participation in the competition

The 26 publications submitted for the competition are distributed in groups in Table 1 as follows: in group B are the publications [18, 19, 24, 25] (all of them in Q1), and in group Γ are the publications [1-17, 20-23, 26] (15 publications are in Q1, and 6 are in Q2). The candidate has significant contributions in the publications [7, 8, 12, 13, 15, 16, 18, 19, 23-26] according to the definition of this term by the Additional requirements of the FP. Even though these publications can have several co-authors, this does not diminish the contribution of the candidate, which consists mainly in carrying out the optical experiment and analysis of the experimental data, because these activities are most important for these publications. The publications of the candidate find a wide response in the field of photochemistry, which can be concluded from a large number of citations of the candidate's publications. Indicative of this interest is also the large h-index of 28, which significantly exceeds the usual value for this field nationwide, and possibly abroad.

In the publications submitted for the competition, the candidate and co-authors report on research in the field of photo-chemistry. The principal part of this research is related to up-conversion, which is a process of conversion of two or more absorbed photons to blue-shifted photons. Special attention is paid to the application of the triplet-triplet annihilation up-conversion (TTA-UC) as the only experimentally demonstrated up-conversion method for the conversion of non-coherent light such as solar light. This method has important practical applications for increasing the absorption of solar radiation in organic photo-solar cells and in the rapidly developing field of organic optoelectronics. The experimental research in this area faces several difficulties related to the reduction of sample size. Many of the problems that arise in such studies are successfully solved using all-optical measurements. The main scientific and applied contribution of the candidate consists in performing precise optical measurements of organic samples using TTA-UC and detailed analysis of the data obtained from these measurements to extract essential and practically useful information about these samples.

In the case of newly synthesized blue-emitting organic molecules, a dependence of fluorescence on the polarity of the solvent has been revealed [1], and photophysical properties have been investigated as a function of solvent type, molar concentration, dissolved oxygen concentration and pumping intensity [4], for a molecule with surface activity and polymerizability, a strong dependence of the fluorescence emission on the polarity of the medium has been observed [6].

In the case of newly synthesized dyes for full optical testing of physiological parameters of organic samples, discrimination of methyl alcohol from ethyl alcohol in aqueous media [9], binding of the dyes to DNA, and demonstration of a strong decrease in fluorescence intensity at a given concentration have been shown, in which respect these dyes are superi-

or to those commercially approved for the case [11]; the change in absorption and fluorescence spectra of dyes in the presence of nucleic acids has been studied and the preferential binding of dyes to DNA compared to RNA has been shown [15]; for chlorine-containing dyes, a more than 110-fold increase in fluorescence signal upon binding to RNA has been demonstrated [20]; for dyes containing N-methylpiperazine structures, a preference for DNA polynucleotides has been demonstrated, accompanied by a substantial increase in fluorescence signal, stabilization of the double helix structure, and induced circular dichroism.

Part of the publications reports the study of all-organic dyes showing photoinduced trans-cis isomerization at low optical pumping intensities. Temporal photoisomerization has been observed in real-time, occurring at extremely low excitation intensities [14], and even at excitation intensities comparable to that of unconcentrated sunlight [18].

Of practical importance are the optically excited triplet states of the sensitized organic molecules because they are an energy reservoir for subsequent emission processes, such as residual phosphorescence at temperatures close to 36°C or delayed fluorescence resulting from TTA-UC. These emission processes in thin polymer layers PF26:PtOEP have been studied with the Stern-Volmer formalism [3]; the optical properties of synthesized Ph4TAQP [7], palladium porphyrin-anthracene dyad [8] and sensitized thieno-thiophene-porphyrin has been investigated [24]. In all these cases, a detailed analysis of the emission processes has been performed.

Another part of the publications is dedicated to the research of TTA-UC processes in multicomponent organic media to control oxygen diffusion in the soft matter for encapsulation of optically active molecules. The barrier properties of a nanocomposite material based on PMMA/ZnO [2], nanocomposite capsules with a liquid hydrophobic core that show ultra-high barrier properties, [10], hybrid nanoparticles with organic and inorganic coatings [12,13,21] have been investigated.

In a series of experimental works, the application of the TTA-UC process has been demonstrated for full optical testing of the characteristics of biological samples, based on its dependence on environmental parameters such as temperature, oxygen concentration, etc. The process has been used for temperature testing of organogels [16], light penetration under human skin [19], and intracellular temperature measurement [17]. The publications in [25,26] are devoted to the optical measurement of the dynamics of the TTA-UC process in soft matter and the manifestation of the complexity of the problem.

Publications

[1]. Kawano et al., *Macromolecules* 41, 2008; [2]. Hess et al., *Macromol. Rapid Commun.* 30, 2009; [3]. Keivanidis et al., *ChemPhysChem* 10, 2009; [4]. Deichmann et al., *J. Phys. Chem. B* 115, 2011; [5]. Busko et al., *Micron* 43, 583–588, 2012; [6]. Sauer et al., *Macromolecules* 45, 2012; [7]. Filatov et al., *Org. Biomol. Chem.* 13, 2015; [8]. Filatov et al., *Dalton Transactions* 44, 2015; [9]. Vasilev et al., *Aust. J. Chem.* 68, 2015; [10]. Svagan et al., *Carbohydrate Polymers* 136, 2016; [11]. Vasilev et al., *Beilstein J. Org. Chem.* 13, 2017; [12]. Katta et al., *Isr. J. Chem.* 58, 2018; [13]. Katta et al., *Beilstein J. Nano-*

technol. 10, 2019; [14]. Kandinska et al., Beilstein J. Org. Chem. 15, 2019; [15]. Zhytniakivska et al., Dyes and Pigments 180, 2020; [16]. Nazarova et al., ChemPhotoChem 3, 2019; [17]. Iyisan et al., Biomacromolecules 21, 2020; [18]. Vasilev et al., J. Mater. Chem. C 9, 2021; [19]. Heinrich et al., ACS Omega 6, 2021; [20]. Kandinska et al., J. Molecular Liquids 342, 2021; [21]. Iyisan et al., ACS Appl. Bio Mater. 5, 2022; [22]. Zonjić et al., Bioorganic Chemistry 127, 2022; [23]. Marx et al., Optometry and Vision Science 99, 2022; [24]. Vasilev et al., Frontiers in Chemistry 10:809863, 2022; [25]. Micheva et al., J. Mater. Chem. C 10, 2022; [26]. Balushev, book chapter, Springer, 2022.

6. Critical remarks and recommendations

I have no essential critical comments.

7. Personal impressions of the candidate

I have no special impressions of the candidate.

8. Conclusion

After getting acquainted with the materials and scientific papers presented in the competition and based on the analysis of their importance and the scientific and applied scientific contributions contained in them, **I confirm** that the scientific achievements of the candidate meet the requirements of ЗРАСРБ, ППЗРАСРБ and ПУРПНСЗАДСУ for the candidate to hold the academic position of "Professor" in the scientific field and professional field of the competition. In particular, the candidature meets the minimum national requirements in the professional field and no plagiarism has been established in the scientific papers submitted for the competition.

I give my **positive assessment** of the application.

II. OVERALL CONCLUSION

Based on the above, I **recommend** to the Scientific Committee to propose to the competent body for the selection of the Faculty of Physics of Sofia University "St. Kliment Ohridski" to elect Associate Professor D.Sc. Stanislav Balushev Balushev to the academic position of "Professor" in the Professional Field 4.1. Physical sciences (Physics of Atoms and Molecules).

01.07.2023

Reviewer:

Sofia

(Prof. Valentin Nikolov Popov, D.Sc.)