

JURY MEMBER'S REPORT

by Prof. Victor Boev, PhD, Institute of Electrochemistry and Energy Systems - BAS
regarding the competition, announced in the State Gazette, issue 79, 04.10.2022 for
occupying the academic position "Assoc. Professor" in the Institute of Optical Materials
and Technologies "Acad. Yordan Malinowski" - BAS in the Professional field 4.1

"Physical science", Scientific specialty "Physics of wave processes"

APPLICANT: Nataliya Berberova-Buhova, Chief Assistant, PhD

1. General presentation of the procedure and the candidate

The only participant in the announced competition, Nataliya Dimitrova Berberova-Buhova, Chief Assistant, PhD, graduated from Sofia University "St. Kliment Ohridski" in 2009. The same year he enrolled for a master's degree in two majors: "Wireless networks and devices" and "Quantum electronics and laser technology", which he successfully completed in 2011. Since 2012, she continued her education at the Institute of Optical Materials and Technologies - BAS as a doctoral student, where in 2016 she successfully defended her dissertation on the topic "Coherent optical metrology: methods and implementation with a spatial light modulator", obtaining the scientific and educational degree "doctor". Currently, Dr. Berberova-Buhova holds the position of "Chief Assistant" in the "Holography" Laboratory at the "Optical Metrology and Holography" Department.

The results of the candidate's overall scientific and research activity are reflected in a total of 56 publications, with the number of noticed citations being 102, and the Hirsch index equal to 5. To participate in the current competition, Dr. Berberova-Buhova has presented a total of 27 scientific publications. Each of these publications is referenced in global databases of scientific information (Scopus and/or Web of Science). Six of them fall into the Q2 category, two into Q3, three into Q4, and sixteen are with SJR. Seven of the publications are thematically united and are presented as the equivalent of habilitation work (group of indicators "C"), and the remaining twenty reflect the results of scientific and activity outside the habilitation work (group of indicators "D"). In addition to the publications, the dissemination of knowledge among the scientific community was carried out by presenting 18 oral reports and 41 poster presentations at a number of prestigious national and international conferences.

It is also necessary to note the candidate's active work on national and international projects. He is the head of a total of 5 projects, one of which was financed under the Program for financing scientific research of young scientists and postdoctoral fellows (in the ranking, this project proposal received the highest number of points), the second - under the Program for supporting young scientists in BAS, the third - under the "Education with Science" program, financed according to an agreement between the Ministry of Education and the BAS, and the remaining two - under the "Science and Business" project, subsidized under the OP "Development of Human Resources". Also, Dr. Berberova-Buhova is a team member in a total of 11 national and 4 international projects, the latter of which were carried out in cooperation with the Institute of Electronics and Communications, South Korea.

Dr. Berberova-Buhova has three international specializations - at Korea Institute of Electronics Technology, Seoul, South Korea, at Tampere University of Technology, Finland, and at National Chiao Tung University, Hsinchu, Taiwan. He holds a Swiss scholarship (World Federation of Scientists - Professor A. Zichichi, Switzerland).

The reference attached by the applicant for the fulfillment of the minimum national requirements according to the Law for the development of the academic staff in the republic of Bulgaria (LDASRB) and the Regulations for the conditions and procedures for acquiring scientific degrees and for holding academic positions at IOMT shows the following distribution

of points by groups of indicators: group "A" (item 1) - 50 points, group "C" (item 4) - 110 points (with a minimum threshold of 100 points), group "D" (item 7) - 236 items (with a minimum threshold of 220 items), group "E" (item 11) - 62 points (with a minimum threshold of 60 items). From the inquiry, it follows that the collected points necessary to meet the minimum national requirements are present, and in all indicators they exceed the minimum required threshold.

2. Evaluation of the major scientific contributions of the candidate

The main scientific activity of Dr. Berberova-Buhova is related to research concerning one of the most modern areas of optics - polarization holography. Unlike scalar holography, which fixes only the modulation of the intensity of the light field on an optical carrier, the polarization holographic record allows recording all the characteristics of the total vector of elliptic polarizations of the light radiation. This implies a multifold increase in the recording capacity, as a necessary condition for its implementation is that the recording medium has pronounced photoanisotropic properties. In addition to reversible recording of optical information with increased density, a number of optical elements important for photonics can be realized on the basis of the above-mentioned media - optical switches, light modulators, polarization splitters, etc. An important prerequisite for this is the creation of a suitable recording medium capable of providing higher values of the photoinduced birefringence, respectively, a higher diffraction efficiency of the polarization diffraction grating.

The research results reflected in the publications equivalent to a habilitation thesis follow the candidate's work on optimizing the composition of thin films of nanocomposites based on the azopolymer PAZO [publ. A1-A7]. The choice of this polymer was dictated by its highly pronounced photoinduced anisotropy under polarized light illumination. It was established that when Au, ZnO, TiO₂ nanoparticles, bioactive complexes based on copper and nickel ions (CLP and NLP) and goethite nanorods (α -FeOOH) are introduced into the polymer matrix, an increase in photoinduced birefringence (Δn) is achieved. The performed assessment of the influence of the size and concentration of the nanoparticles on the modulation of n demonstrates the important role of these two factors in achieving larger values of the photoinduced birefringence. Thus, for nanocomposites containing certain concentrations of Au, ZnO, NLP, CLP and α -FeOOH, an increase in Δn of 24%, 40%, 16%, 14% and 70% was obtained compared to the undoped polymer [publ. A4, A1, A7, A6]. This testifies to a significant increase in the diffraction efficiency of the polarization gratings recorded in these nanocomposite media. For nanocomposites doped with goethite nanorods (α -FeOOH), two characteristic birefringence peaks were observed depending on the concentration of the introduced additive in the azopolymer matrix [publ. A5]. It was also found that the type of solvent required to dissolve the polymer to obtain it in thin-film form also affects the birefringence value, respectively, the diffraction efficiency of the grating created in a photosensitive medium [publ. A3].

In the other publications of the candidate [publ. B1-B20] results outside the habilitation thesis are reflected, and they are divided into three thematic groups. Part of the studies included in the first group [publ. B1-B4], are devoted to multiple polarization holographic recording in layers of azopolymer PAZO and its derivatives (P₁, P₁₋₂, P₂). Reversibility of the birefringence upon erasure of the record by both optical and thermal effects was demonstrated, and the mode of erasure was found to depend on the thermal stability of the azopolymer [publ. B2]. The recording conditions are optimized by changing the polarization state of the recording beams, while the greatest diffraction efficiency is achieved with left and right circular polarizations [publ. B3]. A dependence of the azimuth rotation and the output ellipticity on the input ellipticity was found for thin films of PAZO and of PAZO with TiO₂ [publ. B4].

The second group of publications is focused on the monitoring of rapidly changing processes using dynamic speckle analysis [publ. B5-B12], and using numerical methods for image processing [publ. B13-B14]. The method of speckle analysis has been successfully applied to follow the dynamics of the drying process of a drop of an aqueous solution of PAZO on a glass surface, and the effect of a cosmetic product on human skin [publ. B5-B6]. The rest

of the publications in this group are devoted to creating algorithms for increasing the contrast of the activity map by statistical processing of the speckle images, compression and binarization, numerical simulations and development of approaches aimed at improving the quality of noisy images [publ. B7-B14].

In the third group [publ. B15-B20], a number of models have been proposed to evaluate the diffraction efficiency of a "hybrid" diffraction grating, the optical response of PAZO/TiO₂ nanocomposites, and the complex refractive index over a wide spectral range for PAZO layers doped with Au nanoparticles. In four publications from this group, the name of Dr. Berberova-Buhova occupies the first place in the list of co-authors, which testifies to her substantial contribution to the given publications.

Critical remarks and recommendations

I have no critical remarks.

CONCLUSION

The documents for participation in the competition submitted by Berberova-Buhova, Chief Assitant, PhD, belong to the thematic area of the competition and fully comply with the requirements of the Law for the development of the academic staff in the republic of Bulgaria (LDASRB) and the Regulations for the terms and conditions for acquiring scientific degrees and for holding academic positions at IOMT.

From the applicant's contribution reference, it can be concluded that she has established herself as a qualified scientist capable of planning and conducting independent research work. The significant volume of scientific production, published in a number of renowned scientific publications, unequivocally testifies to the importance of the issues chosen by Dr. Berberova-Buhova as the subject of her scientific activity.

Assessing the high level of expertise, the candidate's ability to independently manage research projects, taking into account her participation in numerous international events and scientometric indicators, I strongly support the choice of Berberov-Buhova, Chief Assitant, PhD for the position of “**Associate Professor**” of IOMT-BAS in the professional direction 4.1 "Physical Sciences".

29.01.2023

Signature of Member of the Jury:
/Victor Boev, Professor, PhD/