

REVIEW

for a competition for the academic position of professor

in professional field 4.1. Physical science, scientific specialty "Physics of wave processes", published in the State Gazette issue 12 / 02.11. 2020, Institute of optical materials and technologies "Acad. J. Malinovski" – Bulgarian Academy of Sciences

With a single candidate: Assoc. Prof. Dr. Dimana Ilieva Nazimova - Associate Professor at IOMT - BAS

Reviewer: prof. Marin Nenchev Nenchev DSc phys and DSc enj. Technical University - Sofia

1. Brief reference - assessment of the basic training and the scientific and teaching formation of the candidate for the scientific position "professor".

The overview shows a solid basic education in physics and the formation of the candidate in the field of the competition. After graduating from specialized school at the Natural Sciences and Mathematics in Haskovo with a physics profile with a gold medal for excellent achievement, she was accepted at Sofia University, majoring in engineering physics. In 1992 she graduated with a master's degree in physics and specialization "Applied Optics" with a thesis in the scientific specialty "Physics of Wave Processes" with supervisors from the Central Laboratory of Optical Storage and Processing of Information - BAS. She also received a second specialty at the Faculty of Physics at Sofia University - a lecturer in physics. In addition, in year 2000 she received a second master's degree in Finance at the University of National and World Economy - Sofia. In 2009 she defended again in CLOSPI - BAS, a dissertation for the award of educational and scientific PhD degree in "Physics of wave processes" (Topic "Optical resonances in periodic and scattering structures"). She makes two research fellowships in 2006 and 2009 in the Center for Industrial and engineering optics in Dublin Institute of Technology - Dublin, Ireland and maintains continuous collaboration with this team.

Since 2003 she has been working in CLOSPI - BAS, which since 2010 has become part of IOMT - BAS. She passed the positions – Research Associate I deg. and Research Associate II deg. and has her Assoc. prof. habilitation in year 2011. She is a member of the scientific council of IOMT. Since 2012 she is the Chairman of the General Meeting of scientists of IOMT and since 2016 has been Head of department "Optical metrology and holography" in IOMT.

The statements about the received education and the formation of the candidate - higher in physics and defense doctorate, in leading educational and scientific organizations such as Sofia University and BAS are convincing moments in the assessment of the acquired scientific competence. It is understandable that what has been said can be realized mainly with a high-quality researcher who can and has something significant to give to the students and doctoral students she teaches, in particular with the opportunities of the professorship.

2. Regarding the general characteristics of the research and scientific - applied activity of the candidate

First - she **fully meets and exceeds** the minimum requirements of NACID for holding the professorship.

The candidate is the author of one chapter of a book, 91 scientific publications, of which 71 with IF and / or SJR, has 132 citations of scientific papers and 111 participations in international and national conferences. She is the leader of 5 national projects (4 from the NSF and one from the Ministry of Education and Science) and she is a private participant in 10 national scientific and educational projects. She participates at 3 international projects and 2 projects with Bulgarian companies. She is a reviewer for European projects; international journals with IF, participation in the commission for the defense of Master, PhD degrees, assistants and associate professors.

For participation in the competition are presented a total of 21 entries, of which 8 with a Q factor Q1, 4 with a Q factor Q3, 6 with a Q factor Q4 and 3 with SJR, which include:

- Equivalent to Habilitation Work - scientific publications in publications that are referenced and indexed in world-famous databases with scientific information (Web of Science and Scopus) (group B) - 6 pcs. ;
- Scientific publications in publications that are referenced and indexed in world-famous databases with scientific information (Web of Science and Scopus), outside the habilitation work, (group D, item 7) - 15 pcs., referenced and indexed in world-famous bases with impact factor (IF).

The total number of publications in which the candidate is the first or second author is 14 out of 21 (66.7 %). All publications are in English. They have been published in international scientific journals.

The candidate presented the necessary evidence for the implementation of the requirements of NACID for the academic position of "professor" (as well as the requirements of BAS and IOMT):

Indicator A - doctor's diploma received by the Higher Attestation Commission;

Indicator B - 105 points out of the required 100 points. 6 pieces are presented - publications equivalent to monographic work, which are in referenced indexed in Web of Science and/or Scopus;

Indicator C - 257 points out of the required 220 points. - 15 pieces are presented - publications that are in referenced indexed in Web of Science and/or Scopus;

Indicator D - 138 points out of the required 120 points. All citations are in scientific literature referenced and indexed in Web of Science and/or Scopus on indicator D-11;

Indicator E - 281 points out of the required 150 points: E-14 (participation in a national scientific or educational project) - 100 points; E-15 (participation in an international scientific or educational project) - 60 points; E-16 (Management of a national scientific or educational project) -100 points; E-18 (Raised funds for projects managed by the applicant) - 21 points;

3. Assessment of the pedagogical activity of the candidate

Assoc. Prof. Dr. Dimana Nazimova is the supervisor of 12 graduated students, of which 2 are with master's degrees, 3 are with bachelor's degrees, and 7 are intern students. Currently she is a supervisor of 2 full-time doctoral students who are in their third year of doctoral studies. In addition, she leads doctoral lecture courses for specialized training in "Light-sensitive materials for optical recording: reversible, irreversible and a new type of organic-inorganic composites" at the Training Center of BAS;

I will note a significant contribution activity in attracting young researchers through participation in various programs, exhibitions and projects such as the "Student practices" organizing holographic exhibitions and others.

4. Major scientific and applied contributions

The contributions of the candidate Assoc. Prof. Dr. Dimana Nazarova have scientific, scientific-applied character and relate to the development and application of new hybrid organic / inorganic media for optical recording based on several polymers, newly synthesized dyes and a wide variety of added nanoparticles in them, theoretical models for diffractive optical structures with different indicators, models for studying the optical response of composite media, as well as approaches for applying dynamic speckle analysis.

The range of results is wide enough to express significant experience, capabilities and competence of the author. The wide range of activities and results can be systematized in several directions:

- New organic / inorganic composite materials were obtained, consisting of three different synthesized polymers: doped with ZnO NPs [16; 17];
- New organic / inorganic composite materials were obtained, consisting of a commercially available water-soluble polymer (poly [1- [4- (3-carboxy-4-hydroxyphenylazo) benzenesulfonamido] -1,2-ethanediyl, sodium salt]), - PAZO, doped with different NPs [3; 10];
- Polarization holographic recording and theoretical modeling of diffractive optical elements with different characteristics in anisotropic hybrid materials was performed [6; 7];
- Features of the polarization record in anisotropic materials - temperature and spectral dependences, time stability and reversibility [9,11,14,18,19];
- Anisotropic properties and polarization recording in various newly synthesized dyes or systems of dyes and matrices [1,2,5,21];
- Development of algorithms for dynamic speckle analysis and their applications for analysis of various activities [4,8,12,13];
- Solving the inverse optical problem and studying the spectral characteristics of thin layers using the Genetic Algorithm [15,20];

Among them I can point out as leading results -

Scientific contributions under indicator "B ":

1. A significant improvement of the photo response in composite materials compared to the undoped layers and stability of the photoinduced birefringence in all newly obtained nanocomposite media has been achieved. More than 40% increase in the saturated birefringence of the amorphous synthesized polymer and a 20% increase in the liquid crystalline polymer was achieved. A recording time reduction of about 30% has also been achieved. These fundamental results for increasing birefringence are fundamental to the quality and efficiency of polarization recording media and are the most basic and significant achievement worldwide.

2. It is also established for each different nanocomposite material what is the optimal concentration of nanoparticles (NPs) for the system of azopolymers and NPs.

3. Studies of the anisotropic properties depending on the size of the NPs show that doping with particles of smaller size (less than 50 nm) provides an increase in the birefringence of the system.

4. It has been found that both the diffraction efficiency and the surface relief height for the recorded diffraction relief polarization gratings in the hybrid layers are increased compared to those recorded in the pure azopolymer layers. This is indisputable proof of the possibilities for applications of hybrid materials.

5. A theoretical evaluation of the optical response of a stack of two diffraction gratings with the same one - dimensional periodicity is made. The first is the relief structure of the surface; the second - volume polarization grating. A good agreement was found between the theoretical model and the experimental data on the diffraction efficiency and the birefringence of the layers.

Scientific contributions under indicator "D":

1. Reversible polarization recording was performed using two different erasing methods - by temperature and by illumination with circularly polarized light. It was found that all four tested polymers: P1, P12 and P2, synthesized in IOMT and PAZO (Sigma-Aldrich) are optically reversible, while the thermal reversibility is applicable only to the first three. The maximum values of their birefringence are also determined. These results are important for applications based on reversible optical recording of information.

2. A recording of birefringence at different temperatures was realized. It has been found that the maximum birefringence strongly depends on the temperature. It has been shown that the maximum photoinduced birefringence does not depend on the thickness. This allows the optimal combination of parameters to be selected for a given application.

3. It has been found that the birefringence stability of the liquid crystal polymer is significantly higher than that of the amorphous polymer. It has also been found that the birefringence in a wide spectrum of the amorphous polymer has sufficiently high values and allows its use in the entire visible spectral range.

4. The birefringence in nanocomposite thin layers of three newly synthesized perillane bis azo-imides in a polyimide matrix by vacuum evaporation of ODA (4,4'-oxydianiline) and PMDA as a host polymer was obtained and recorded. The corresponding perylene bis azo-imide dyes is used as a "guest". It has also been found that nanocomposite layers have improved their photo response compared to dye layers.

5. Experimental evidence has been obtained that the cis isomer of the bisazo dye Mordant Pure Yellow is anisotropic and reorients perpendicular to the direction of polarization of the incident light. Photoinduced dichroism has also been shown to be stable one month after irradiation.

6. An algorithm resistant to non-uniform illumination and with reduced computational complexity for transforming the captured 8-bit coded speckle pictures into binary pictures by applying a point threshold has been proposed. The proposed algorithm is applied to the processing of experimental data from drying of polymer droplets.

7. It is proposed to filter the maps by intensity in order to improve visualization and quantification of time scales of activity. A significant narrowing of the probability density functions has been achieved. Filtered maps show improved contrast and allow quantitative description of activity.

8. The dynamic speckle technique is applied to detect the drying process of an aqueous solution of PAZO polymer. The obtained two-dimensional distributions of this function for different time lags confirmed the efficiency of the dynamic speckle analysis for monitoring processes in aqueous solutions of polymers.

9. A new statistical measure for calculating a modified time structural function is proposed, which provides the same contrast of the activity map as the other algorithms, but with less computational effort. The algorithms are applied to process speckle pictures of real objects.

10. The genetic algorithm for determining the optical characteristics of tantalum pentoxide layers is applied. The equivalent physical thickness and the equivalent refractive index of the interfacial layer formed between the oxide and the silicon substrate during the deposition process, as well as the thickness of the tantalum pentoxide layer were evaluated. The optical characteristics of Ta₂O₅ layers doped with Hf, Al and Ti were also obtained. These theoretical estimates contribute to the practical applications of the resulting thin films.

5. Significance of the contributions to science and practice and the teaching qualification of the candidate.

The candidate's scientific contributions are significant both for basic science and for practical applications in the field of optoelectronics, photonics and sensors. They meet the state requirements for a professor and the requirements of IOMT - BAS.

6. Notes and recommendations

Recommendation - based on the high qualification and the great activity in the participation in national and international projects and programs, I recommend such an active attitude in the expansion of the relations with national and foreign universities and new contracts with the participation of students and doctoral students. Interuniversity relations with leading world technical countries are an important moment for the integration of Bulgarian science to the level of leading European countries. The candidate gives a lot in this direction and has the potential for even more.

CONCLUSION

The presented materials meet the requirements of ZRASRB, the Regulations for its application and the internal Regulations for the terms and conditions for holding academic positions in IOMT - BAS. Based on the acquaintance with the presented scientific papers, their significance, the contributions contained in them, as well as the particularly significant activity and activity of the candidate in participation in national and international projects and programs, I find it reasonable to propose Assoc. Prof. Dimana Nazarova, PhD., to take the academic position of "professor" in a professional field 4.1. Physical sciences, scientific specialty "Physics of wave processes".

Date: 24. 07. 2020

Reviewer:

/ Prof. DSc Phys. and DSc enj. Marin Nenchev /