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 35, 10.05.2022 for occupying the academic position "Professor" in the Institute of Optical Materials and Technologies "Acad. Yordan Malinowski" - BAS in the Professional field 4.1 "Physical science", Scientific specialty "Electrical, magnetic and optical properties of condensed matter"

APPLICANT: Assoc. Prof., PhD Lian Lubenov Nedelchev

1. General presentation of the procedure and the candidate

The single applicant in the announced competition, Assoc. Prof. Lian Lyubenov Nedelchev, graduated from the Sofia University "St. Kliment Ohridski", Faculty of Physics in 1997. After obtaining a Master's degree in "Laser Physics", he continued his education at the Central Laboratory for Optical Recording and Processing of Information (CLORPI-BAS) as a PhD student. After dismissal with the right of defense, he worked as a researcher at Optilink company and in Rizzo National Laboratory in Roxilde, Denmark from 2001 to the end of 2002. In 2004, he defended his PhD thesis, titled "Photoinduced processes in azobenzene-containing polymers and their application", obtaining his doctor's degree. After that, Assoc. Prof. Nedelchev was engaged in teaching activities at the High School of Telecommunications and Posts (HSTP), where he won a competition for an "Associate Professor", and within four years of this period he was also the dean of the Faculty of Telecommunications and Management. In 2011, he was appointed as an "Associate Professor" in the Institute of Optical Materials and Technologies (IOMT) "Acad. Yordan Malinowski", which was created on the basis of union of the Central Laboratory of Photo-processes (CLAFOP) and CLORPI. In the period from 2014 to 2015, he was a member of the Institute's Scientific Council (SC), and from 2022 he was again included in the SC of IOMT. Currently, Assoc. Prof. Nedelchev holds several responsible administrative positions: head of the Laboratory "Holography" at the "Optical Metrology and Holography" Department, secretary of the Colloquium of IOMT and Scientific Secretary of IOMT.

The results of the overall research activity of Assoc. Prof. Nedelchev are reported in a total of 95 publications, 78 of which are referenced and indexed in the world databases Scopus and/or Web of Science. Over 350 independent citations were identified, the majority of which were from journal articles indexed in WoS or Scopus. The Hirsch index, calculated and shown in the same databases, is equal to 13.

Assoc. Prof. Nedelchev has submitted a total number of 21 scientific publications for participation in the competition. Each of these publications is referenced in the global databases of scientific information (Scopus and/or Web of Science). Two of them fall into the highest quartile category - Q1, nine - in Q2, two - in Q3, three - in Q4, and five are with SJR. Seven of the publications are thematically united and are presented as the equivalent of a habilitation work (group of indicators "C"), and the remaining fourteen publications, as well as one certificate of registration of a utility model, reflect the results of his scientific activity outside the habilitation work (group of indicators "D").

The candidate also has an active role in attracting funds provided for the implementation of scientific and educational projects. Under his leadership, two projects were successfully implemented with national funding from the Scientific Research Fund (NSF) and the Ministry of Education, Youth and Science (MEYS). The documents submitted by the candidate also confirm his participation in 4 more national and 2 international projects, the latter of which

were carried out in cooperation with the Institute of Electronics and Communications, South Korea.

Assoc. Prof. Nedelchev was the co-supervisor of one doctoral student who successfully defended his thesis, of one doctoral student who was dismissed with the right of defense, and the supervisor of a number of graduate students and specialists under the "Student Practice" program. He is the author of a textbook on "Physics" for students, intended for use in the HSTP school network (group of indicators "F").

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 terms and conditions for acquiring scientific degrees and for holding academic positions at IOMT shows the following distribution of points by groups of indicators: group "A" - 50 points, group "C" (item 4) - 109 points (with a minimum threshold of 100 points), group "D" (item 7) - 262 points. (with a minimum threshold of 220 points), group "E" - 140 items (with a minimum threshold of 120 points), group "F" (item 13, item 14, item 15, item 18, item 19) - 209 points (at a minimum threshold of 150 points). From the reference it follows that the points collected, necessary to cover the minimum national requirements in all indicators exceed the minimum threshold, which is a testimony to the successful career development of the candidate and the high quality of his scientific output.

2. Evaluation of the major scientific contributions of the candidate

Assoc. Prof. Nedelchev's scientific activity is primarily related to the study of photoinduced changes that photoanisotropic materials undergo under action of polarized light, optimization of the conditions for polarization holographic recording and study of processes taking place in azopolymers, azo dyes and nanocomposites based on them. The importance of this topic is due to the fact that the discovery of new materials possessing the ability to reorient their constituent molecules under the influence of the electric vector of the light field, in combination with up to date optical research methods, create objective prerequisites for the production of highly efficient polarization holographic gratings for a number of important optical elements - optical shutters, light modulators, polarization splitters, etc.

The research results reflected in the publications equivalent to habilitation work are divided into two groups. Those of the first group are devoted to optimization and numerical modeling of photoinduced birefringence in thin layers of azopolymers and azo dyes, as well as to studying the process of multiple reversible polarization recording (publ. A1-A4). The main parameters of photoinduced birefringence in PAZO polymer layers have been determined: time of response, stability and optimal wavelength at which the maximum modulation value is reached (publ. A1, A3). Reversibility of the birefringence under both optical and thermal impact has been demonstrated (publ. A2). Using the Monte-Carlo method, a special numerical algorithm was developed to follow the evolution of the induction, relaxation and optical erasure of birefringence processes. This approach is applicable to a very large number of molecules (over 400,000). The obtained simulations successfully describe the kinetics of all three processes (publ. A4).

In publ. A5-A7, referring to the second group, the influence of photoinduced chiral structures on the efficiency of polarization holographic gratings was analyzed. The kinetics of recording in PAZO polymer and of PAZO doped with TiO_2 nanoparticles were investigated, using a laser beam with different ellipticity (publ. A5, A7). It was found that for the nanocomposite layer, the azimuth rotation per unit thickness increased by almost 50% compared to that of the undoped azpolymer. Based on the experimentally determined photoinduced circular birefringence, a graphical dependence of the diffraction efficiency on the azimuth of the sample beam was constructed for a polarization holographic grating recorded with two orthogonal polarizations (publ. A5). The ability of azopolymers to

reversibly switch the direction of chirality by changing the sign of ellipticity was also observed. The formation of chiral structures has been found to occur significantly faster than the induction of linear birefringence in such recording media (publ. A6).

The remaining publications of the candidate (publ. B1-B14) reflect results outside the habilitation work, and they are divided into three thematic groups. In the first group (publ. B1-B5), the optical properties of the nanocomposites based on copolymers doped with nanoparticles of various chemical composition, size and shape were studied. The influence on the value of photoinduced birefringence of the azopolymers upon doping with spherical gold nanoparticles (publ. B1, B3), bioactive metal complexes based on copper and nickel ions (publ. B2), goethite nanorods (publ. B4) and chalcogenide particles of the system was investigated Ge-Te-Cu (pub. B5) was investigated. In the second group (publ. B6-B9), devoted to optical registration of polarization and relief gratings, the contribution of volumetric birefringence and relief scalar grating to the overall diffraction efficiency was evaluated (publ. B6). It was reported that more than 30% of the diffraction efficiency was achieved for PAZO layers with bioactive metal complexes (publ. B7). The influence of layer preparation conditions on the diffraction efficiency was discovered in publ. B 8. The dependences of the first-order diffraction efficiency on the ellipticity of the sample beam were determined in publ. B9. The third group of publications (pub. B10-B14) is focused on monitoring the drying process during deposition of the azopolymer layers by dynamic speckle analysis and analysis of mechanical properties of the layers.

The proposed system for improving the polarization properties of a polarization diffraction optical element, described in the useful model (C1), also has a significant scientific and applied contribution. It is necessary to note the participation of Assoc. Prof. Nedelchev as the first author in the list of the authors, which developed this element (circular polarization beam splitter), in which a significant (10-fold!) improvement of the polarization properties was achieved at the expense of suppressing the negative influence of the surface relief of grid by filling it with transparent adhesive and pressing the azopolymer layer with an additional cover glass.

Critical remarks and recommendations

I have no critical remarks.

CONCLUSION

The documents for participation in the competition submitted by Assoc. Prof. Nedelchev, 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.

In addition to a fundamental orientation, the scientific and applied nature of the obtained results is also evident, demonstrating the possibility that azopolymers and nanocomposites based on them can be effectively used for the production of polarization optical elements necessary for creation of functional optical devices (for example, a spectral polarimeter). This unequivocally proves the importance of the problem that the candidate has chosen as the subject of his scientific activity.

Evaluating the high level of competence, taking into account the candidate's active publication, project, popularization activity, as well as his recognition in the scientific circles, I firmly support the election of Assoc. Prof. Lian Lyubenov Nedelchev as a professor at IOMT-BAS in professional direction 4.1 " Physical Sciences".

05.09.2022

Signature of Member of the Jury: .....

/Victor Boev, Professor, PhD/