

STATEMENT

by competition for the academic position "Professor"

Professional field: 4.1 "Physical sciences",

Scientific specialty: "Electrical, magnetic and optical properties of condensed matter"

according to the announcement in the Newspaper of State, issue 35 of 10.05.2022

for the needs of the Institute of Optical Materials and Technologies (IOMT)

"Acad. J. Malinowski", Bulgarian Academy of Sciences

with the only candidate: Assoc. Prof. Dr. Lian Lyubenov Nedelchev

Member of the Scientific Jury: Prof. DSc Vera Marinova - IOMT, BAS

Associate Professor Dr. Lian Lyubenov Nedelchev is the only candidate in the competition for the academic position "Professor", announced in the Newspaper of State, issue 35 of 10.05.2022 for the needs of IOMT - BAS.

1. General characteristics of the presented materials.

In the competition for the academic position "Professor", Assoc. Dr. Lian Lyubenov Nedelchev participated with a total of 19 scientific publications, published at refereed international journals, including:

- 7 publications equivalent to a habilitation thesis published in journals with impact factor/impact rank SJR (referring to indicator B4)
- and 14 publications in journals with an impact factor/impact rank (referring to indicator Д).

The habilitation thesis (indicator B4) includes 7 publications, of which 1 in the Q1 category, 2 in the Q2 category, 2 in the Q4 category and 2 published in SJR. The publications were published in the period 2016-2021 and are related to the research and optimization of the optical properties of photoanisotropic materials - azopolymers and azopolymer-based nanocomposites; as well as applying polarization holography for recording polarization diffraction gratings, polarization-selective optical elements, surface-relief structures and analysis of their characteristics, etc. In three of them, Assoc. Dr. Lian Nedelchev is the first author.

The publications outside the habilitation work are a total of 14 (referring to indicator Д), all of which are printed in refereed and indexed in the world-famous databases Web of Science and Scopus), including 1 publication in category Q1, 7 publications in category Q2, 2 publications in category Q3, 1 post in category Q4, and 3 posts with SJR. In 3 of them, the candidate is the first author. For indicator Д.9, the candidate has also presented 1 useful model.

There are 70 marked citations under the competition procedure.

The number of participations in conferences is 73.

To date, Associate Professor Dr. Lian Nedelchev has co-authored 95 articles (and one article in press), of which 78 have been published in publications indexed in WoS and/or Scopus. The total number of noticed citations is 340, h-factor 13.

According to the requirements for occupying the academic position "Professor", laid down in the Law on the Behavior of the Academic Staff in the Republic of Belarus (ZRAS-RB) and the rules for the terms and conditions for acquiring scientific degrees and holding academic positions IOMT-BAS, the candidate Dr. Lian Nedelchev presented:

to indicator A - 50 points (from a minimum of 50 points)

to indicator B - 109 points (from a minimum of 100 points)

to group of indicators D - 262 points (from a minimum of 220 points)

to D 7. - 14 scientific publications in publications referenced in Web of Science and Scopus, outside the habilitation thesis - 237 points

to D .9 - 1 useful model to indicator D -25 points

to indicator D - 140 points (from a minimum of 120 points)

Citations in scientific publications, monographs, collective volumes and patents - 140 points

to indicators E-E.14, E15, E16, E18, E19 and E20 - total 209 points (from a minimum of 150 points)

Guidance of successfully defended doctoral students and guidance for participation in national and international scientific or educational projects, Published university textbook

Total points for all indicator groups A, B, D, D and E: 770 points

The scientific metrics of the candidate Associate professor Dr. Lian Nedelchev fully cover the requirements for occupying the academic position "Professor" laid down in the Regulations of ZRAS-RB, ZRAS-BAS and IOMT-BAS.

2. General characteristics of the candidate's scientific, scientifically applied and pedagogical activities

Assoc. Prof. Dr. Lian Nedelchev completed a master's degree in Laser Physics at the Faculty of Physics of Sofia University "St. Kliment Ohridski" in 1997. In the same year, he began a full-time PhD student at the Central Laboratory of Optical Recording and Information Processing, TCLOSPI (currently IOMT). His research activities were focused on the study of polarization holographic gratings and photoinduced chiral structures, as well as the development of a laser refractometer with an interference device for angle measurements.

In 2004, he successfully defended his PhD thesis on the subject: "Photoinduced processes in azobenzene-containing polymers and their application". This was followed by a two-year specialization at the Rizzo and Optilink National Laboratory, Denmark.

Since 2011, Dr. Nedelchev has been an associate professor in the "Optical Metrology and Holography" department at IOMT-BAS.

Dr. Nedelchev is the scientific leader of 2 projects with the National Institute of Scientific Research, and participant in 6 national projects and 2 international projects.

Assoc. Dr. Lian Nedelchev has also been involved in administrative activities in IOMT-BAS: since 2015 - until now he is the Secretary of the Institute Colloquium, and recently was elected as Scientific Secretary of IOMT - BAS.

Teaching and lecturing activities:

At IOMT-BAS, Assoc. Dr. Nedelchev is the co-supervisor of two doctoral students (one defended and one with pending defence), as well as numerous graduates and specialists under the "Student Practices" program.

In addition to research activities, Assoc. Dr. Lian Nedelchev also has a prominent teaching activity at the Higher School of Telecommunications and Posts in the period 2009-2021, where he lectures on "Physics", "Fundamentals of Electronics", "Electronics", "Fundamentals of Electrical Engineering", "Mathematics".

Associate Professor Nedelchev also wrote a "Physics" textbook for students

3. Basic scientific and/or scientific-applied contributions with an assessment to what extent they are the candidate's personal work.

The main research activity of Assoc. Dr. Lian Nedelchev is focused to optimization of the optical properties of photoanisotropic materials like azopolymers and nanocomposites for their applications as media for polarization recording of information (polarization diffraction gratings, polarization-selective optical elements, surface -relief structures). It is obvious from the applied documents that Associate Professor Dr. Nedelchev is a very experienced researcher and has a leading role the obtained experimental results to be successfully published in prestigious journals.

Major Scientific Contributions

The scientific contributions of Associate Professor Dr. Nedelchev have a fundamental and applied nature focused on research and optimization of anisotropic polymer materials for polarization holographic recording and can be briefly summarized as following:

I. Photoinduced birefringence in thin films of azopolymers and azo dyes - experimental optimization and numerical modelling.

In this field, a non-destructive method for determining the thickness of thin layers has been proposed; birefringence kinetics of PAZO azopolymer were obtained and the

maximum value ($\Delta n_{\max}$), response time (τ) and birefringence stability (r) were determined. In addition it was found that the highest value of $\Delta n_{\max} = 0.081$ and the shortest response time $\tau = 10$ s were achieved at 442 nm wavelength; reversibility of birefringence in an azopolymer synthesized in IOMT is demonstrated, showing write/read/erase cycles of birefringence either optically (by irradiation with circularly polarized light) and thermally (by heating above a certain temperature, in this case 90° C); obtained birefringence kinetics under 355 and 444 nm irradiation for vacuum deposited layers of the 4-aminoazobenzene azo dye Azo-d; a numerical simulation was carried out by means of Monte Carlo modeling of the processes of induction, relaxation and optical erasure of birefringence.

II. Investigation of photoinduced chiral structures in azopolymers and azopolymer nanocomposites.

In this area, the azimuth rotation kinetics for PAZO azopolymer layers as well as for nanocomposite layers of the same polymer doped with 2% titanium dioxide (TiO₂) nanoparticles under laser beam irradiation with ellipticity varying from -1 (left circular polarization) to +1 (right circular polarization) with the maximum azimuth rotation values of 33°/μm for the azopolymer layer and 46°/μm for the nanocomposite layer being determined; the calculated dependence of the diffraction efficiency on the azimuth of a linearly polarized sample beam for polarization gratings recorded with two orthogonal linear polarizations; the parameters of photoinduced chiral structures for layers of the PAZO azopolymer and the azopolymers synthesized in IOMT were determined; the possibility of reversibly switching the direction of chirality by changing the sign of the ellipticity of the pumping radiation is demonstrated; the dependences of azimuth rotation and output ellipticity on input ellipticity for chiral structures induced in TiO₂-doped PAZO nanocomposite samples have been determined.

III. Optical properties of azopolymer nanocomposites containing nanoparticles of different chemical composition, size and shape

In this field, nanocomposite layers based on azopolymer PAZO and doped with spherical gold nanoparticles of different sizes and concentrations, bioactive metal complexes based on copper ions (CLP), nickel ions (NLP), and also doped with goethite nanorods have been successfully obtained. The parameters of the photoinduced birefringence (maximum value, response time and stability over time) were determined.

IV. Polarization and surface-relief gratings recorded by polarization holography in azopolymers and azopolymer nanocomposites

Here should be noted the proposed system for improving the polarization properties of a polarization diffraction optical element, representing a circular polarization beam splitter, which included a cover glass attached with an optically transparent adhesive to the photoanisotropic layer. In this way, a 10-fold improvement in polarization properties was achieved compared to those of a grating recorded on an uncoated sample.

4. Reflection of the candidate's scientific publications in our and foreign literature:

The indicated citations to the scientific publications with which the candidate participated in the competition according to Web of Science and Scopus are 70.

The total number of citations of all scientific publications of the candidate is 340.

5. Critical notes of the reviewer on the presented works, including the candidate's literary awareness

in some places the fundamental and applied contributions described by the candidate are too detailed, which detracts from the essence of what was achieved. This of course does not at all detract from the values of the applicant's contributions. I have no critical remarks.

6. Personal impressions of the reviewer about the candidate

I have known Assoc. Prof. Dr. Nedelchev since almost the beginning of his scientific career. His research activity is based on an exceptional knowledge of polarization holography methods. Over the years, I have been impressed by the pedagogical approach with which Associate Professor Dr. Nedelchev explains a scientific problem and shares his knowledge and experience. Last but not least, I think that Dr. Nedelchev treats his commitments very responsibly and professionally.

7. Reasoned and clearly formulated conclusion.

The materials and scientific works of Assoc. Dr. Nedelchev presented at this competition characterize the candidate as a very well-qualified specialist in the study of the anisotropy of polymer materials and their applications in polarization holography. Here I would like to note the active participation of associate professor Dr. Nedelchev in various projects at the national and international level, the patent activity, as well as the teaching activity

On the basis of the above, I express my full support for the candidacy of Assoc. Dr. Lian Nedelchev and with conviction I recommend to the honorable Scientific Jury to support and propose to the NS of IOMT-BAS that Assoc. Dr. Lian Nedelchev be elected to the academic position "Professor" to Professional direction: 4.2 "Physical Sciences".

08.09.2022

statement written by:

/Prof DSc Vera Marinova /