

O P I N I O N

by Assoc. Prof. Daniela Bogdanova Karashanova, PhD
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on the competition for holding the academic position "Associate Professor" announced at IOMT-BAS, department "Optical Materials"
in professional field "4.1. Physical sciences", scientific field "Electrical, magnetic and optical properties of condensed matter"

1. General presentation

By order № RD-15-463 of July 8, 2022 of the Director of IOMT-BAS I have been appointed as a member of the scientific jury, on the competition for holding the academic position "Associate Professor" in professional field "4.1. Physical sciences", scientific field "Electrical, magnetic and optical properties of condensed matter".

The only candidate in this competition, published in the Bulgarian State Gazette, issue 35 of May 10, 2022 was **Chief Assistant Professor Dr. Velichka Yordanova Strijkova-Kenderova**.

2. Assessment of the scientific and research accomplishments of the candidate

The results of Dr. Velichka Strijkova's research activities, outside of her doctoral studies, and after 2014, were developed within the framework of 10 research projects and were presented at 26 scientific forums, by 39 oral and poster presentations. During her research activity, Dr. Strijkova co-authored 67 scientific publications, 41 of which appeared in journals with an impact factor or impact rank and received a total of 104 citations from other authors.

Dr. Strijkova presented 19 of these publications for her participation in the current competition for the position of "Associate Professor" announced at IOMT-BAS. All of them are published in journals with "impact factor" and "impact rank" and distributed in quartiles as follows: 8Q1, 8Q2, 3Q4. Among the journals, where the articles were published, the renowned ones in the field of materials science - Nanomaterials, in the study of surfaces and coatings - Coatings, in the study of biological materials with various methods, incl. Atomic Force Microscopy - International Journal of Molecular Sciences, Sensors and Biosensors are remarked.

6 of the presented in the completion publications are the core of the habilitation thesis, and the remaining 13 are presented in addition. The presented citations from other authors in the world databases Scopus and Web of Science are 50, collected by 6 publications.

These indicators provide the necessary pointes, corresponding to the minimal national requirements, published in the Development of Academic Staff in the Republic of Bulgaria Act (DASRB), the Rules for the Application of the Development of Academic Staff in the Republic of Bulgaria Act, the Rules of BAS and in the Rules set at the IOMT-BAS and even exceed them in most of the indicators. The candidate's Hirsch index, according to the Web of Science database, is h=6.

3. Research activity and contributions of the candidate

In general, Dr. Strijkova's research activity is devoted to the study of the surface morphology and mechanical properties of various materials – inorganic and organic thin layers, biological objects, etc. The topics of her research coincide with the important for the European and global research areas such as Medicine and quality of life, Fight against socially significant diseases (Alzheimer's disease, Parkinson's disease, etc.).

The part of Dr. Strizhkova's research activity, published in the period 2017-2021 in 6 articles in "impact factor" journals and the basis of the **habilitation thesis**, is focused on the one hand

on the study of morphometric and nanomechanical characteristics of erythrocytes in normal and pathology and on the other - on the study of the conditions for holographic recording of gratings with adjustable polarization and surface relief, carried out in azopolymer PAZO and in azopolymer nanocomposites with the method of Atomic Force Microscopy (AFM).

A relationship between the morphology of red blood cells (RBCs) and their mechanical properties, in particular elasticity, in patients exhibiting certain pathologies (e.g. women with risky pregnancy, patients suffer of neurodegenerative diseases) and deviations in other blood parameters, was asked and established in order to discover the role of RBC in multiple pathological states. Based on the obtained results, new, non-invasive approaches for the diagnosis of these diseases have been successfully proposed and a step has been taken towards adequate treatment of still incurable diseases, such as neurodegenerative diseases - Alzheimer's disease, Parkinson's disease and amyotrophic lateral sclerosis.

Scientific contributions in research on the second topic are related to finding the height and period dependence of diffraction gratings created in layers of pure PAZO polymer, as well as in nanocomposite layers of this polymer and different types of nanoparticles (ZnO, Au, α -FeOOH and etc.) from some basic parameters of polarization recording systems – layer thickness and holographic recording angle. Determining these dependencies makes it possible to record surface-relief gratings in azopolymers with tunable parameters (period: from 800 nm to 2000 nm and height: over 250 nm), which will find numerous applications, such as all-optical micro- and nanopatterning of materials, polarization multiplexing, etc. Atomic force microscopy measurements of the surface diffraction gratings in pure and nanoparticle-doped PAZO layers reveal higher diffraction efficiency and modulation of the surface relief of the gratings in the case of nanocomposite layers and provide evidence for the role of particles in the diffraction recording process as support the hypothesis of a stronger effect of the free volume on the diffraction efficiency, compared to the scattering of light by the particles themselves.

The role of Dr. Strijkova in these studies is essential and refers to the overall characterization of the provided systems with the method of AFM, the analysis of the obtained results for the shape, size, roughness and elastic properties of the erythrocytes and the relief of the organic or hybrid layers in order to clarify some of the registered states in these systems and mechanisms of certain phenomena.

Publications outside the habilitation thesis are divided into 5 thematic areas:

1. Transparent conductive doped zinc oxide layers with applications as transparent electrodes and energy harvesting devices - covers 4 publications
2. Two-dimensional (2D) dichalcogenides of transition metals as materials with applications in optoelectronics – 2 publications
3. Atomic layer deposition AlN with application in surface acoustic wave devices - 3 publications
4. Development of a polymer dye medium for use as an active medium for lasers – 2 publications
5. Application of surface plasmon resonance for clinical analysis or as a biosensor – 2 publications

In these studies, the main contribution of the candidate is related also with the determination by means of atomic force microscopy of the surface morphology, roughness and mechanical properties of thin films and nanoscale materials. This group of publications presents the results of measuring these characteristics of inorganic materials - produced by radio frequency (RF) sputtering pure ZnO films and doped with Al and Ga – deposited on different types of substrates, including flexible ones; AlN layers prepared by atomic layers deposition (ALD); flakes of 2D materials such as WSe₂ and WTe₂, and also on organic and biological objects - a new medium for laser radiation generation, consisting of an epoxy polymer as a matrix for

rhodamine 6G and rhodamine B binary solutions, as well as directly immobilized layers of hemoglobin and myoglobin on a diffraction grating and on Si substrates by the matrix-assisted pulsed laser evaporation (MAPLE) method, serving as an active biosensor media with surface plasmon resonance detection.

The activities carried out by Dr. Strizhkova lead to a complete characterization of the surface morphology and some properties of the studied systems, reflecting on the synthesis process and leading to the optimization of the conditions for their preparation, with the aim of further applications of these materials in optoelectronics, sensors, etc.

Last but not least, it should be mentioned the pedagogical activity that Dr. Stryikova conducts - training in physics and astronomy in secondary school (grades 7, 9, 10, 11 and 12), specialized qualification courses in optics for specialists in "Optical Optics" course, internships and demonstrations in front of students, students and doctoral students on the basic principles of operation of the atomic force microscope, the optical profilometer, etc.

CONCLUSION

Documents and materials presented by the candidate in the competition, Chief Assistant Professor Velichka Yordanova Strijkova-Kenderova, PhD, fully comply with the requirements of the Development of Academic Staff in the Republic of Bulgaria Act (DASRB), the Rules for the Application of the Development of Academic Staff in the Republic of Bulgaria Act, the Rules of BAS and with the Rules set at the IOMT-BAS.

The contributions described in the publications correspond to the topic of the announced competition for "Associate Professor" in the field "Electrical, magnetic and optical properties of condensed matter", are substantial and original. That is why **I give a positive assessment** of the scientific work and activities presented in the competition and I recommend the honorable members of the Scientific Jury to prepare a report with a proposal to the Scientific Council of IOMT-BAS, **Dr. Velichka Yordanova Strijkova-Kenderova to be elected as an Associate Professor at IOMT-BAS**, in professional field 4.1. Physical Sciences (Electrical, Magnetic and Optical Properties of Condensed Matter).

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Opinion prepared by:

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