

OPINION

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. Kateriana Emilova Lazarova**.

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

The results of Dr. Katerina Lazarova's research activities, outside of her doctoral studies, were developed within the framework of 13 research projects, 3 of which she herself is the leader, she is a participant in 10 other projects and is the coordinator for IOMT of one infrastructure project INFRAMAT.

Dr. Lazarova is a co-author in 41 scientific publications (9 of them are the basis of her PhD thesis), 25 of which appeared in journals with an impact factor or impact rank and received a total of 110 citations. She has presented the results of her research activity at 60 scientific forums.

Dr. Lazarova presented 20 of these publications for her participation in the current competition for the position of "Associate Professor" announced at IOMT-BAS. They are all published in *impact factor* and *impact rank* journals and distributed by quartiles as follows: 7Q1, 3Q2, 6Q4, 4SJR. Among the journals, the renowned ones in the field of materials science and sensor properties of materials are Nanomaterials, Materials, Polymers and Sensors.

6 of the presented publications are the core of a habilitation thesis, and the remaining 14 are presented outside of it. The presented citations from other authors from the world databases Scopus and Web of Science are 31, collected for only 2 publications, which indicates that the research of Dr. Lazarova and co-authors is up-to-date and finds a good response in the international scientific community.

These indicators provide the necessary points, 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. Lazarova's research activity is devoted to the synthesis of thin polymer, zeolite and composite films, the study of their optical properties in order to establish their sensory response in relation to humidity and some other analytes, such as volatile organic compounds. With this, the topic of research coincides with actual and important European and global research areas such as Ecology, Environmental Protection, Medicine and Quality of Life.

The part of Dr. Lazarova's research activity, published in 6 articles in *impact factor* journals and the basis of the **habilitation thesis**, is focused on the deposition of thin layers of co-polymers such as poly(N,N-dimethylacrylamide) and poly(ethylene oxide) in different ratios, tracking their reaction – color change when the relative humidity changes from 5% to 95%. The influence of the architecture of the polymer chains on the reaction of the films in the presence of humidity was also investigated, and an impressive resolution of 0.3% RH was achieved.

Films of hydrophobically modified co-polymers based on poly(vinyl alcohol-co-vinyl acetal) were also investigated, which were found to improve the sensor properties compared to pure poly(vinyl alcohol) ones. Poly(vinyl alcohol-co-vinyl acetate) hybrid layers have also been deposited with the addition of SiO₂ particles. The use of a metallized glass substrate was applied, in order to measure the optical characteristics in the transmission mode, as well as a silicon substrate, providing a good separation of the color coordinates in the color space.

A flexible optical humidity sensor was also developed on a polymer basis, consisting of a metallized substrate of poly(ethylene terephthalate) and an active element – a thin film of poly(vinyl alcohol-co-vinyl acetate).

The scientific contributions in these studies are related to the finding of humidity-sensitive materials, the deposition of high quality films and the preparation of a methodology for the detection of humidity by registration of the change in the films' colors.

The results of the research in the habilitation thesis were presented at 21 scientific forums, and were awarded twice for the best presentation.

Dr. Lazarova's role in these studies is essential and concerns both the preparation of the layers and their optical characterization, measurement of their sensory characteristics and the publications whiting. This is evidenced by the fact that she is the first author in all 6 publications.

Publications outside the habilitation thesis are divided into 3 thematic areas:

1. Characterization of the optical and sensing properties of nanocomposites of metal oxides and zeolites - covers 6 publications
2. Development of photonic crystals of metal oxides and/or composites – 4 publications
3. Investigation of optical characteristics of ZrO₂ thin films obtained by different synthesis and doped with rare earth elements - 3 publications

One publication is on the subject of the habilitation thesis - Humidity detection using a polymer films.

In these studies, the main contribution of the candidate is also in the deposition of thin zeolites films with different composition and in combination with metal oxides, which films possess specific optical parameters, allowing the application of the materials in humidity sensors with optical detection.

Another significant contribution is related to the controlled deposition by the sol-gel method of thin films of Nb₂O₅, V₂O₅ and Ta₂O₅, construction of multilayer systems from them - Bragg stacks, their structural and optical characterization and control of their refractive index and absorption coefficient for sensing (reaction in the presence of water vapor and acetone) and anti-reflective applications.

Important results were also achieved in the preparation of transparent and homogeneous films of ZrO₂ by the sol-gel method. Their optical properties were investigated by measuring their photoluminescence. The films were also deposited with various additives during the synthesis, as well as doped with rare earth elements (Sm), which undoubtedly affected their optical parameters - degree of transmittance, photoluminescence band, refractive index and expanded the range of their values in comparison to those of pure ZrO₂ films, thus enabling a variety of applications.

CONCLUSION

Documents and materials presented by the candidate in the competition, Chief Assistant Professor Katerina Emilova Lazarova, 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. Katerina Emilova Lazarova 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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