STATEMENT

by competition for the academic position "Associate Professor"

Professional field: 4.1 "Physical sciences",

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

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

for the needs of IOMT - BAS,

with a single candidate chief- assistant Dr. Katerina Emilova Lazarova

statement prepared by: Dimitre Zahariev Dimitrov, professor, Ph.D., ISSP-BAS

Chief- Assistant Dr. Katerina Emilova Lazarova is the only candidate in the competition for the academic position "Associate Professor", announced in the State Gazette, 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 "Associate Professor" Dr. Katerina Lazarova participated with a total of 20 scientific publications in refereed international publications, all with an impact factor and impact rank, including:

- 6 publications published in journals with impact factor (x5) and impact rank (x1) are presented for habilitation work (referring to indicator B)

- and 14 publications in journals with an impact factor (x11) and an impact rank (x3) respectively (referring to indicator Г).

The habilitation thesis (indicator B) includes 6 publications, of which 3 in the Q1 category, 1 in the Q2 category, 1 in the Q4 category and 1 with impact rank. The publications were published in the period 2017-2021. and are related to research on polymeric materials, structures and devices for optical moisture sensors.

The publications outside the habilitation thesis are a total of 14 (referring to indicator Г), all of which are published in refereed and indexed in the world-famous databases (Web of Science and Scopus), including 4 publications in category Q1, 2 publications in category Q2, 5 publications in category Q4, and 3 publications with impact rank. In five of them, the candidate is the first author.

There are 41 citations noted for the competition procedure.

The number of participations in conferences is 61 (38 with reports and 23 with poster presentations).

The ONS PhD thesis on "Porous one-dimensional photonic crystals of metal oxides and nanoscale zeolites for sensing applications" is written and defended on the basis of 6 publications in impact-factor/impact-rank journals, 3 full-text conference publications and 17 participations in international conferences.

Until now, Chief Assistant Dr. Katerina Lazarova is a co-author in a total of 41 scientific articles, 110 citations have been noticed. h-Index-5.

In accordance with the requirements for holding the academic position "Docent", laid down in the Law on the Attainment of the Academic Staff in the Republic of Bulgaria (ZRASRB) and the rules for the conditions and procedures for acquiring scientific degrees and holding academic positions IOMT-BANS, candidate chief assistant. Dr. Katerina Lazarova presented:

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

to indicator B - 117 points (from a minimum of 100 points)

to group of indicators Г - 230 points (from a minimum of 220 points)

Г7. 14 scientific publications in publications referenced in Web of Science and Scopus, outside the habilitation thesis - 230 points

to indicator D 11 -82 points (from a minimum of 60 points)

Citations in scientific publications, monographs, collective volumes and patents - 82 points

The scientometric indicators of the candidate chief assistant. Dr. Katerina Lazarova fully meet the requirements for occupying the academic position "Associate Professor" laid down in the Regulations of ZRAS RB, ZRAS-BAS and IOMT-BAS.

2. General characteristics of the candidate's scientific and applied scientific activity

Dr. Katerina Lazarova has a bachelor's degree in Physics and Mathematics, she completed a master's degree in Physics, both at SU "St. Kliment Ohridski", in 2004 and 2006, respectively. For over 6 years, she worked as a Physics and Astronomy teacher, a mathematics teacher. From 01.01.2013, a full-time doctorate at IOMT-BAS begins. In 2015 successfully defended ONS "doctor" on the topic: "Porous one-dimensional photonic crystals of metal oxides and nano-sized zeolites for sensor applications"

Currently, the candidate participates in 19 scientific research projects (leader of 5 of them) funded by the National Research Institute, as well as the Coordinator for IOMT in the national scientific infrastructure INFRAMAT (2018-2022). Finalist in the Carroll Foundation competition for a €2,500 scholarship to support PhD students with a significant contribution to their field.

Awards: 2 awards for best poster; 3 awards for the best oral report/lecture; won fellowships for specialization at LCS, Caen, France and for training at CERN, Switzerland. Won a scholarship under the National Program "Young scientists and postdoctoral fellows".

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

The scientific contributions of Chief Assistant Dr. Katerina Lazarova can be grouped thematically in several different areas of research:

- study of the optical and sensory properties of thin films of different, moisture-sensitive polymers;

- development of a flexible moisture sensor with optical detection;

- characterization of the optical and sensor properties of nanocomposites of metal oxides and zeolites;

- development of photonic crystals from metal oxides and/or composites;

- study of the optical characteristics of ZrO2 thin films, obtained by different synthesis and doped with rare earth elements.

Scientific contributions under indicator B:

- For the first time, the possibility of using thin films of poly(N,N-dimethylacrylamide) and poly(ethylene oxide) (PDMA/PEO) copolymers with different composition and structure as sensitive media for optical moisture detection has been successfully demonstrated. Films of PDMA/PEO di- and triblock copolymers synthesized by reduction-oxidation (redox) polymerization in aqueous medium change their color as the humidity changes from 5% to 95% RH, which can be detected with the naked eye. The color change is shown to be due to the significant swelling of the films, which in turn leads to a red-shift of the minimum of the reflection spectra, as well as a decrease in the refractive index due to a decrease in film density. It was found that there is a relationship between the polymer structure and the annealing temperature of the films and that they affect the optical response in different ways.

-For the first time, the relationship between chemical composition/macromolecular architecture and the optical and sensor properties of block copolymer thin films containing poly(N,N-dimethylacrylamide) (PDMA) has been investigated. The macromolecular structure was found to affect both the sensitivity and the level of hysteresis H. It was shown that the most suitable polymer for optical moisture detection is one with a branched macromolecular architecture, which achieves an optimal balance between sensitivity and hysteresis

- Double hydrophilic copolymers with complex branched structures containing PDMA and poly(ethylene oxide) blocks have been successfully used as moisture-sensitive optical media. A resolution of 0.3% RH was achieved, which is very close to the best resolution reported in the literature for optical moisture detection so far. The successful detection of color change at different humidity in the cases of sensor polymer layer deposited on Bragg stack and on metallized glass in transmission mode is demonstrated.

- The ability of thin films of four different hydrophobically modified PVA copolymers with different copolymer compositions to be used for optical moisture detection is demonstrated.

- An improvement of the sensor properties was shown by the use of hybrid films of acetal-modified PVA polymers with added silica. The use of a metallized glass substrate (gold/palladium coated) for transmission mode measurement has also been successfully demonstrated.

- A flexible and transparent polymer-based optical humidity sensor has been successfully developed, operating without the need for electricity and obtained by a relatively simple and inexpensive method. The influence of up to 1000 bending strains on the surface morphology and optical quality of the sensor was found to be negligible.

Scientific contributions under indicator Г:

- Zeolite films obtained by spin-coating an aqueous dispersion consisting of pure silica crystals with MFI type structure (Si-MFI) and small sizes (35 nm) have been successfully deposited. Their optical properties were studied and the possibility of controlling the optical thickness of the zeolite films by changing the concentration or the deposition rate by rotating the substrate was demonstrated. The possibility of their use as anti-reflection coatings for a wide spectral range is shown.

- an optimization of the optical and sensory properties of Nb205 and SiO2 films was achieved by doping with EMT and MFI type crystalline zeolites, and for Nb205 the possibility of varying the refractive index of the composites within very wide limits by changing the amount of zeolites was demonstrated. An increase in sensitivity of more than 3 times was achieved.

- The all-optical detection of acetone/acetone vapor through thin films doped with fly ash zeolites has been demonstrated for the first time.

- Thin films of Nb2O5 have been successfully deposited by spin-coating Nb sol on a silicon substrate. Nb sol was prepared by using niobium chloride as a source of Nb and ethanol as a solvent using sonication. It was found that aging the ash during the first week did not lead to changes in the deposited films. It has been shown that precise control of the film thickness can be achieved by controlling the sol concentration, and varying n in the range of 1.82 to 2.20 can be achieved by annealing.

- By alternating thin films of Nb205 and by embedding a "defective" layer, vapor-sensitive Bragg stacks were obtained. It is shown that optical contrast can be achieved by alternating low and high refractive index films by varying the refractive index and using porous and dense layers of Nb2O5. The required porosity in the films was achieved through the so-called soft-templating method. A more than 10-fold increase in sensitivity was achieved when detecting acetone vapors. By introducing a "defective" layer into the stack, a 20% improvement in response was achieved compared to a stack without a "defective" layer.

- Transparent V205 thin films with high refractive index and good optical quality were successfully deposited using different synthesis and deposition conditions. Porous films were developed. Good permeability of V205 thin films and their potential for use in multilayer systems have been established.

- Thin films of Ta2O5 have been successfully deposited using the sol-gel method. All films were demonstrated to be suitable for use as an active medium for the optical detection of acetone vapor.

- Transparent and homogeneous ZrO2 films were successfully obtained by the sol-gel method using different acids as stabilizing agents, by spin-coating homogeneous thin films of ZrO2 with 3 different additives during the synthesis and thin films of samarium doped (0.5- 5%) ZrO2 with high optical quality by the sol-gel method using an inorganic zirconium precursor. Optical properties for potential applications are determined.

When obtaining the results/contributions described in this way, Dr. Katerina Lazarova participated in the entire work process: the planning of the experiment, the deposition and characterization of the films, the collection, processing and analysis of the results, their summarization and subsequent presentation at scientific conferences, as well as in writing articles.

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 41.

The total number of citations of all scientific publications of the candidate is 110.

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

I don't have any

6. Personal impressions of the reviewer about the candidate

I know Ch. Assistant Professor Katerina Lazarova from the beginning of her scientific career and I have very good impressions of her scientific and research activities at IOMT.

7. Reasoned and clearly formulated conclusion.

The submitted materials and scientific works of Dr. Katerina Lazarova characterized the candidate as a very well-qualified specialist with well-defined research topics of a fundamental and applied nature.

The indicated data show that the scientometric indicators of Dr.Katerina Lazarova, PhD, fully satisfy the requirements for holding the academic position "Associate Professor", laid down in the Law on the Regulation of the Academic Staff in the Republic of Bulgaria (ZRASRB) and the regulations on the terms and conditions for acquiring scientific degrees and holding academic positions of the IOMT - BAS.

On the basis of the above, I express my full support for the candidacy of Ch. Assistant Dr. Katerina Lazarova and with conviction I recommend to the honorable Scientific Jury to support and propose to the National Assembly of IOMT-BAS Ch. Dr. Katerina Lazarova, assistant professor, to be elected to the academic position of "Associate Professor" in the Professional field: 4.1 "Physical Sciences", scientific specialty: "Electrical, magnetic and optical properties of condensed matter".

07.09.2022 statement by:

/prof.d-r. eng.D.Dimitrov/