R E P O R T

For the competition for the academic position „Associate Professor" in the professional field 4.2. Chemical Sciences (Inorganic Chemistry), announced in State Gazette 47/04.06.2021 by the Institute of General and Inorganic Chemistry-BAS for the needs of the High-Temperature Oxide Systems Laboratory.

Member of the Scientific Jury: Assoc. Prof. Dr. Ruzha Harizanova, University of Chemical Technology and Metallurgy

1. Applicant's personal and professional information

Only one applicant, Senior Assist.-Prof. Dr. Margarita Kirilova Milanova participates in the Associate Professor competition in the professional field 4.2. Chemical Sciences (Inorganic Chemistry) announced in the State Gazette 47/04.06.2021 by the Institute of General and Inorganic Chemistry-BAS for the needs of the High-Temperature Oxide Systems Laboratory.
Dr. Milanova graduated with a Master degree from the Sofia University "St. Kl. Ohridski", with professional qualification "Chemist" and a second specialty "Teacher in Chemistry and Physics" in 1997. From April, 2003 till 2005 she works as a chemist, between 2005-2008 as a research associate II degree, between 2008 and 2010 – as a research associate I degree and from 2010 till now – as a Senior Assist.-Prof. at the IGIC-BAS. In 2005 she defends a PhD thesis entitled "Synthesis and characterization of amorphous and polycrystalline molybdate-based materials" with scientific supervisors Prof. DSc Yanko Dimitriev and Prof. DSc Dimitar Klisurski at IGIC-BAS. Between 2010-2021 Margarita Milanova specializes: at the Chemical Faculty of the Bilkent University, Ankara, Turkey (2010-2012); April-September 2014 – with a scholarship from the Matsumae International Foundation at the Osaka Prefecture University, Osaka, Japan; with Erasmus grants - at the Institute of Theoretical Physics and Chemistry at the National Hellenic Research Foundation (2018); at the University of Aveiro, Aveiro, Portugal (2019) and at the Center for Energy Research, Budapest, Hungarian Academy of Sciences, Hungary (2021).

2. General description of the materials presented for the competition

Senior Assist-Prof. Margarita Milanova is applying for the Associate Professor competition with the total number of 42 scientific publications, 21 of these in IF journals, 9 – in peer reviewed scientific journals without IF and 12 – in conference proceedings. Most of the publications are in renowned international and leading Bulgarian scientific journals, the largest number of works being published in Journal of Non–Crystalline Solids (Q1) – 8, Journal of Mater. Sci (Q1) – 4, Phys. Chem. Glasses B (Q2/Q3) – 3, Catalysis Today (Q2) – 2, Journal of Chemical Technology and Metallurgy (former Journal of the University of Chemical Technology and Metallurgy) (Q3 from 2012) - 4 and Bulgarian Chemical Communications (Q4) – 3.
In the present Associate Professor competition, Dr. Milanova applies with 38 publications in total. 8 of them are presented instead of a habilitation thesis - 3 are published in scientific journals with Q1, 1 is in a magazine with Q2 and 4 papers – in journals with Q3. The works submitted as non-habilitation materials are also published in scientific magazines with quartiles as follows Q1 (5), Q2 (2), Q3 (3) and Q4 (1). The applicant has also presented a list with her contributions at 41 scientific forums in total – 28 from which are at international and 13 at national meetings. A total of 146 citations of the scientific works of Dr. Milanova was

noticed in the Web of Science and/or Scopus databases, from which 99 are of the scientific publications with which the candidate applies for the competition and 5 citations are from Google Scholar. The Hirsch-index (h) of Dr. Milanova, according to Scopus, is 7. The applicant took part in 7 scientific projects – 5 national financially supported by the BNSF, 1 – national supported by NSI ESHER and 1 – national funded by the National center for new materials UNION.

All materials presented by Dr. Milanova for the competition correspond to the topic of the competition and exceed for some of the criteria the Minimal National Requirements as defined in the Law for the Development of the Academic Staff in the Republic of Bulgaria (LDASRB) and the Regulation for the Application of LDASRB for the academic position "Associate Professor" in 4. Natural Sciences, Mathematics and Informatics, professional direction Chemical Sciences, as well as in the Rules on the Terms and Conditions for Acquisition of Academic Degrees and Occupation of Academic Positions at IGIC-BAS (859 points in total from 500 required).

3. General characteristics of the research activities and main scientific contributions

The main research activities of the candidate are in the field of the synthesis and characterization of oxide glasses and polycrystalline materials with optical, catalytic, photocatalytic and electrical properties in systems containing oxides of the transition metals (MoO_3, WO_3, ZnO, V_2O_5, Nb_2O_5) in the composition.

3.1 Main contributions in the publications substituting for the habilitation thesis

The main contributions in the materials submitted for the competition concern the synthesis and the local structure investigation of multicomponent oxide glasses containing in their composition non-traditional and traditional glass-formers and of crystalline compounds mainly by means of Raman and IR-spectroscopy. The microstructure is investigated by using the method of the scanning electron microscopy. Aiming a more complex characterization of the obtained materials, a number of contemporary characterization methods are used including X-ray photoelectron spectroscopy, diffuse reflectance UV-Vis and X-ray absorption fine structure spectroscopy (XAFS). The following fields of research interests could be outlined, according to the submitted materials for the competition, which correspond to the structural characterization of multicomponent oxide glasses with the participation of WO_3, MO_3 and B_2O_3 as glass-formers and investigation of the structure and the main types of bonds occurring in the obtained amorphous materials.

The submitted contributions for this indicator concern the candidate's investigations dedicated to the synthesis, investigation of the structure and valence states of non-traditional molybdate and tungstate glasses in case of binary and multicomponent systems, in whose compositions oxides of heavy, transition and rare-earth elements are included and no classical glass-formers are present. This investigations have both fundamental and practical aspect and represent a significant contribution for the understanding of the relation "composition-structure-glass forming tendency" in the systems MoO_3-CuO, MoO_3-Bi_2O_3, MoO_3-CuO-Bi_2O_3, MoO_3-La_2O_3-Nd_2O_3, MoO_3-CuO-PbO, ZnO-Bi_2O_3-WO_3-MoO_3, WO_3–ZnO–Nd_2O_3–Al_2O_3, ZnO-WO_3-La_2O_3-Al_2O_3, B_2O_3-Bi_2O_3-La_2O_3-WO_3. The results from the performed investigations contribute to the elucidation of the factors, influencing the choice of compositions aiming the synthesis of new glass-like materials with valuable from practical point of view properties such as superionic and electronic conductivity, high density and transmittance in the visible and near infra-red range, high refractive index and high thermal stability which determines their potential for application as amorphous semiconductors, superionic conductors, solid electrolytes, thermal and mechanical sensors, active media for various optical elements, optical fibers, microwave dielectrics. Within the submitted as a substitution of the habilitation thesis publications, an important contribution is the elucidation

of the possibility by the addition of a traditional glass-forming oxide such as B_2O_3 to the above mentioned systems to improve the glass-forming ability and to decrease the melting temperature, as well as to improve the optical properties of the prepared glasses and glass-crystalline materials. An interesting result in the investigations of Dr. Milanova is the raised hypothesis according to which the occurrence of the glass network in the studied tungstate and molybdate systems is result from the presence of octahedral MoO_6 or WO_6 units, which is not typical for the glass networks built by traditional glass-formers. It was pointed out that the glass-forming in these two non-traditional systems is the result of the occurrence of bridging bonds from the type Mo-O-Me and W-O-Bi(Zn). The hypothesis is raised that, based on the obtained results for the glass-forming tendencies in compound molybdate and tungstate systems, the respective dependencies could be also applied to other systems containing MoO_3 and WO_3, and could be utilized as a basis for the design of compositions of new technological glasses.

3.2 Main scientific contributions in the non-habilitation publications

In the publications presented as non-habilitation work (group of indicators G, indicator 7, 11 publications), there are again contributions concerning the glass-forming ability and the thermal properties of complex molybdate and tungstate glasses and these represent a continuation of the work reported in stead of the habilitation thesis. The second part of the scientific work presented for this indicator is dedicated to the preparation of crystalline vanadate and molybdate phases with catalytic, photocatalytic and electrical properties (publications 1, 2, 3, 4, 7, 9). In this part of the scientific investigations, the main contributions of the work of Dr. Milanova could be summarized as the development and utilization of new synthesis methods for the preparation of crystalline molybdate and vanadate phases with catalytic, photocatalytic and electrical properties, which methods differ from the conventional and thus, most often used methods for the synthesis of this compounds. As a next contribution within the work presented for indicator G, the investigation of the local structure and morphology of the obtained crystalline phases can be pointed out. The method of the mechanically activated solid state synthesis has been successfully applied for the preparation of the crystalline phase $FeVO_4$, which is a stable and selective catalyst with electrochromic properties and photcatalytic activity in the decomposition of organic pollutants. The crystalline compound, $LiVMoO_6$, which is a promising electrode material for lithium ion batteries, has also been synthesized (1, 7). An important contribution in the work of Dr. Milanova is the establishment of the fact that the preliminary mechanical treatment of stoichiometric mixtures from the raw materials leads to substantial decrease of the time and the temperature of the solid state synthesis of the respective crystalline phases. A methodology consisting of several types of methods has been developed for the synthesis of the crystalline compound $LiVMoO_6$ (melt-quenching method, via “soft” mechanochemical synthesis and by means of controlled crystallization from glass). The advantages and disadvantages of the different synthesis methods have been compared and the influence of the synthesis method on the obtained microstructure has been studied. Furthermore, the influence of the addition of B_2O_3 during the synthesis of $LiVMoO_6$ has been investigated and the effect of the boron oxide addition on the structure and the electrochemical characteristics of that electrode-active phase has been established. The investigations on $LiVMoO_6$ as an active material in a composite electrode in a model solid state electrochemical cell with a lithium-indium anode has been reported for the first time in the publications of Dr. Milanova. According to the performed electrochemical tests, $LiVMoO_6$ remains stable during the cycling and is a promising candidate for the preparation of electrode-active phases in solid state lithium ion batteries (4). Another contribution from this group of works submitted as

non-habilitation thesis is the establishment of the possibility for the successful synthesis of the crystalline phases α-$Bi_2Mo_3O_{12}$ and β-$Bi_2Mo_2O_9$, which are of practical importance due to their applicability as catalysts in the industrial organic synthesis, by using the method of controlled crystallization from glass. Monophase samples with a very narrow crystal size distribution and average size below 1 micrometer are obtained (3).

4. Impact of the publications in the literature

The total citations' number of the publications of Dr. Milanova is 146 (Web of Science, Scopus), from which 58 citations are for the publications substituting the habilitation thesis and 88 - for the non-habilitation publications. The most cited publications are 4 from those substituting the habilitation thesis (31 citations) and 5 from the non-habilitation publications (16 citations) which are dedicated to the studies of the glass-forming ability of the molybdate glasses and the applicability in sensor technology of the tungstate glasses, respectively.

5. Critical notes and recommendations regarding the applicant's research activity

I have no critical comments on the materials submitted for the competition.

6. Evaluation of applicant's personal contribution and personal impressions

The publications with which Dr. Milanova applies for the competition are the result of team work with researchers with interdisciplinary scientific competence. The average number of co-authors for the publications substituting for the habilitation thesis (8 in total) is 4,6, Dr. Milanova being the 1 author in 4 of them and a second author in 2. In the non-habilitation publications (11 in total), the average number of authors per publication is 5,1 and Dr. Milanova is the first author in 5 of them and in 4 publications is the second author. In 11 of the publications she is the corresponding author. These data as well as my personal observations from the research activity of the applicant allow me to conclude that her personal contribution to the presented investigation is significant and indisputable.

I have known Ms. Margarita Milanova since the time she was a PhD student at the IGIC-BAS. I had the opportunity to observe her scientific progress during the years and could claim with conviction that she is a conscientious researcher who is performing well-planned and designed experiments. She makes the impression of a perceptive and truthful scientist who is aware of and skillfully combines in her research different physical and physicochemical methods and is capable of performing analytical interpretation of the obtained results which is a prerequisite for a future successful scientific career.

CONCLUSION

Senior Assist.-Prof. Margarita Milanova has submitted in the competition materials which correspond and even, for some of the indicators, exceed the criteria recommended for the occupation of the academic position "Associate Professor" at the Institute of General and Inorganic Chemistry–BAS. Based on all of the above – the well-selected and up to date scientific topics, the quantity and quality of the presented scientific publications, the well-defined personal scientific contributions of the applicant and my positive personal impressions, I recommend with conviction

Senior Assist-Prof. Dr. Margarita Milanova

to be appointed at the academic position of Associate Professor in the professional field 4.2.Chemical Sciences (Inorganic Chemistry) at the Institute of General and Inorganic Chemistry - BAS.

Member of the Scientific Jury:

10.09.2021 Assoc. Prof. Dr. Ruzha Harizanova