REPORT

by Assoc. Prof. Dr. Irina Dimitrova Stambolova, Ph.D.

Institute of General and Inorganic Chemistry - BAS,

member of a scientific jury

regarding the materials for the competition for the occupation of the academic position

"Associate Professor" in professional field 4.2. "Chemical sciences", scientific specialty "Inorganic chemistry", for the needs of the laboratory "High-temperature oxide materials" of the IGIC, announced in the State Gazette, issue 46 /26.05.2023

1. General presentation of the candidate and description of the presented materials

Dr. Maria Nikolova Gancheva received her master's degree in 2001 at the Chemical Technology and Metallurgical University-Sofia. In 2007, she obtained a scientific and educational degree "doctor" with a dissertation entitled: "Comparative studies on the synthesis of molybdate and tungstate phases containing zirconium and nickel". Since 2008 holds the academic position of " Assistant professor" at the Institute of General and Inorganic Chemistry - BAS.

According to the submitted report on the fulfillment of the minimum requirements of the LASRB (Law on the Improvement of the Academic Staff in the Republic of Bulgaria), the total number of points collected by the candidates is 1079 points, with a minimum number of points for occupying the academic position of Associate Professor, a total of 500 points. It is noteworthy that for each of the individual indicators (A-D), the scientometric data of the candidate exceed two or more times the permissible minimum points. For participation in the competition, ch. assistant professor Maria Nikolova Gancheva, PhD, has presented a total of 28 (23 of them are outside the habilitation work) scientific publications. A very large part of them are published in referenced and indexed in world-renowned databases, publications with the highest rank /quartile and 2/ and high impact factor: *Ceramics International, Journal of Alloys and Compounds, Journal of Non-Crystalline Solids, Journal of Materials Science, Materials Chemistry and Physics, Materials Today:Proceeding,* etc. which confirms its originality and topicality of the subject. In 18 of the scientific works, the candidate is the first or second author, which proves beyond doubt her participation as the lead researcher and her substantial contribution to the creation of the publications.

The high research activity and competence of Dr. Gancheva is also confirmed by the participation in 5 scientific projects financed by the Bulgarian National Science Fund (BNSF). Three of the projects are in the field of synthesis of glass-ceramic oxide materials with optical applications, one - in the field of systems for production, storage and consumption of clean energy. Dr. Gancheva also has teaching experience as a project manager at the Student Institute of the BAS.

The candidate participated in 27 scientific forums and conferences: (18 international and 9 national).

The Hirsch index is 10 (with a minimum of 5), with a total number of citations of 385 (according to Web of Science and/or Scopus), of which 219 are of the publications, included in the competition.

2. Basic scientific and applied contributions

The main scientific and applied contributions are in the field of inorganic materials science and can be summarized as synthesis, physicochemical characterization and investigation of the properties of the obtained materials, with a view to their application in optics, catalysis and photocatalysis.

The scientific activity and main contributions, according to the presented scientific works of Dr. Gancheva can be divided into three directions:

(a) Most of the publications are devoted to the preparation of $ZrMo_2O_8$ and rare-earth-doped glass from the $CaO\text{-}GeO_2\text{-}Li_2O\text{-}B_2O_3$ system, by applying the melt quenching method and characterizion of the optical properties

The melt quenching method was used for the first time for synthesis of $ZrMo_2O_8$ and $ZrMoWO_8$ crystalline phases. It is shown to be applied at different cooling rates of water to obtain a high-temperature modification of ZrMo2O8 – trigonal (α), all cubic or crystalline at low cooling rates, whilw at high rates-dendritic.

The glass systems of $CaO\text{-}GeO_2\text{-}Li_2O\text{-}B_2O_3$ doped with rare earth elements (Eu^{3+}, Dy^{3+}, Tb^{3+}) were synthesized by means of the melt quenching method. The influence of active ions on the structural units of the amorphous network and on their optical properties were investigated. The color of the emitted light is determined depends on the amount and type of dopant.

(b) Another group of works concerns the application of mechanochemical synthesis, which has a number of advantages in terms of quality, time and energy consumption. A wide range of tungstates ($CuWO_4$, $ZnWO_4$, $SrWO_4$, $BaWO_4$) and molybdates $ZrMo_2O_8$, $MgMoO_4$ were obtained and studied. Important data has been obtained regarding the phase transformations of $ZrMo_2O_8$, It was proved that pure trigonal (α) $ZrMo_2O_8$ was obtained after annealing at 600^{o}C for 5 hours after mechanochemical activation of the initial oxides. The phase transitions of $ZrMo_2O_8$ depending on the thermal treatment of $ZrMo_2O_7(OH)_2.2H_2O$ are also described in detail. It was established that after annealing at 400^{o}C a mixture of cubic and trigonal (α) $ZrMo_2O_8$ is obtained, while at 450^{o}C - a pure phase of trigonal (α) $ZrMo_2O_8$ with spherical particles was obtained.

(c) a significant part of the publications are devoted to the study of the photocatalytic activity of promising powder photocatalysts as zinc oxide, as well as $ZrMo_2O_8$.

Nanosized ZnO powders have been obtained by various synthesis methods. It was found that the mechanical treatment of basic zinc carbonate /1000 rpm/ leads to a higher degree of decomposition of basic zinc carbonate, as a result ZnO with a crystallite size of 14 nm was prepared. ZnO nanorods was successfully synthesized by means of sonochemical method and the band gaps of the samples were determined. The higher photocatalytic activity under the UV light of sonochemically prepared ZnO compared to that of the mechanochemically synthesized ZnO is explained by the morphology and size of the particles.

Pulsed laser deposition (PLD) has been successfully applied to obtain thin, highly porous ZnO films with a band gap 3.22 eV.

The photocatalytic activity for the degradation of malachite green dye using trigonal (β) $ZrMo_2O_8$ thermally treated at two different temperatures (450°C and 600°C) was investigated and compared. The higher specific surface area and the presence of more deformed structural units of MoO_4 tetrahedra in the sample treated at 450°C, which is the reason for their higher photocatalytic activity.

3. Personal impressions, remarks and recommendations to the candidate

I know Dr. Maria Gancheva and I have very good direct impressions of her scientific activity on project in the field of synthesis and photocatalytic properties of zinc oxide. Along with the indisputable professional qualities of Dr. Gancheva, I would like to note her tolerant and collegial attitude towards the employees of the institute. I have no critical remarks.

4. Conclusion

The presented materials from Assist. Prof. Dr. Maria Nikolova Gancheva, fully comply with all the minimum and mandatory criteria of LASRB and the Regulations for the Terms and Procedures for Acquiring Scientific Degrees and Holding Academic Positions at the IGIC - BAS.

The attached materials characterize the candidate as an established researcher with excellent capabilities, competence and prospects for further development in the field of inorganic chemistry and materials science.

Based on all of the above, I recommend the Scientific Jury to **propose to the National Assembly of the IGIC - BAS to choose Assistant Professor Dr. Maria Nikolova Gancheva, in the academic position "associate professor"** professional field 4.2. Chemical Sciences, scientific specialty "Inorganic Chemistry",

3.09.2023

Assoc. Prof. Dr. Irina Stambolova