

## REVIEWER'S OPINION

Submitted by Prof. PhD Alexander Eliyas – Institute of Catalysis - BAS in regard to the materials, represented for participation in the competition for occupying the academic position „Associated Professor" in the Institute of General and Inorganic Chemistry - BAS

On the basis of Order № RD-09-130 dated 17.07.2023, issued by the Director of the Institute of General and Inorganic Chemistry - BAS (IGIC-BAS), I was appointed to be member of the Scientific Jury for carrying out the competition procedure, announced by IGIC-BAS for occupying the academic position „Associated Professor" in IGIC-BAS in the professional direction 4.2 „Chemical Sciences", scientific specialty „Chemical Kinetics and Catalysis", announced for the needs of the Laboratory „Materials and Processes for Protection of the Environment“ of the Institute of General and Inorganic Chemistry - BAS based on its publication in Newspaper of State (Official Gazette) Issue 46 dated 26.05.2023 following a decision, taken by the Scientific Council of IGIC-BAS (Record of the Proceedings № 8/11.07.2023). On the date 7.08.2023 there was an on-line session of the members of the jury and I was appointed to prepare a reviewer's opinion. I have at my disposal the Regulations concerning the conditions and the order for occupying academic positions in IGIC-BAS and I received a flash memory, containing respectively all the required documents for the procedure: a copy of the announcement in Newspaper of State, curriculum vitae of the only candidate, participating in the competition, diploma for the educational and scientific research degree Ph.D. „Philosophy Doctor“, certificate for the length of service in this specialty and certificate for the term of occupying the academic position „Chief Assistant“, verification for the minimum of requirements of BAS and IGIC for academic positions, a total list of all the research publications, accompanied by proof evidences, as well as a total list of the noticed citations, lists of participation in conferences and in scientific research projects, submitted for participation in the competition, other materials - honorary diplomas, awards, certificates for specializations, as well as a verification list for the fulfillment of the minimum of the requirements for the academic position of „Associated Professor“, habilitatory verification of the scientific research contributions, reprints of the publications, submitted for participation in this competition and summaries of the reviewed publications.

### **1. General presentation of the obtained materials**

The only candidate, participating in the competition for occupying the academic position of „Associated Professor", announced in Newspaper of State (Official Gazette) Issue 46 dated 26.05.2023 and on the Internet web page of the Institute of General and Inorganic Chemistry - BAS, is the chief assistant PhD Ralitsa Velinova. The complete set of materials, represented by her is in complete accordance with Article 29 of the Law of Development of the Academic Staff of the Republic of Bulgaria, Articles 31 and 32(1) of the Regulations for awarding scientific degrees and the conditions and the order for occupying academic positions in the Bulgarian Academy of Sciences and also in accordance with the Regulations for the conditions and the order for occupying academic positions in the Institute of General and Inorganic Chemistry - BAS.

The candidate has Diploma, issued by the Higher Attestation Commission of Bulgaria №34155 for the educational and scientific PhD degree dated 31.05.2010 and it is in the scientific specialty 02.10.12 „Technologies for silicates, binding compounds and hardly melting non-metallic materials" on the basis of defended PhD Thesis on the topic „Antique and Medieval Glasses in the Bulgarian Lands" at the University of Chemical Technology and Metallurgy, Sofia, acquired on 30.03.2010. She specialized at the University in the town of Aveiro, Portugal during the period from 01.03.2001 to 31.07.2001. Then she started working in IGIC - BAS, occupying the position of „Chemist" on 18.03.2008 and then she continued occupying this position until 22.11.2010, when she was appointed in the position of „Chief Assistant" at first in the Laboratory „Analytical Chemistry" until 16.10.2017, and thereafter in the Laboratory „Materials and Processes for Protection of the Environment" until now.

The candidate has a total of 39 research publications, out of which 32 papers are published in journals having impact factor, 2 other publications journals having no impact factor, 4 in conference proceedings in full text and 1 book chapter. She represented a list of 17 publications for participation in the competition for the position of Associated Professor, apart from the list of publications, included in the PhD Thesis. As one can see from the submitted materials among these 17 publications - 6 papers are published in journals having impact factor belonging to the category quartile Q1, 6 publications are in journals having impact factor belonging to the category quartile Q2, 4 papers are in journals Q3 and there is 1 book chapter.

In the represented verification for the fulfillment of the minimal requirements of BAS and IGIC one can see, that in the Index Group B the indices 3 or 4 the candidate has 115 points exceeding the required minimum of 100 points, so in view of this index she is exceeding the requirements. It should be noted that in 5 of the research publications she is the

first author - these are publications №1, 6, 8, 11 and 13. This verification also shows that the in the Group G the sum of the values of the indices from 5 to 10, whereupon the required minimum is 220 points, the candidate has a total of 230 points, i.e. with respect to this index too she exceeds the requirements. In the case of Index 11, Group D she has 144 points, where the requirement is to have 60 points - this exceeds considerably the requirements. As far as the sum of Indexes 21 to 29 Group J, where the needed number of points is 70 points for associated professor she has a total of 100 points. Taking into account the fact that the minimal total number of points is 500 points in order to answer the requirement for associated professor I would like to underline the fact that she has a total of 639 points in the Table for Groups of Indices, represented in the Verification for fulfillment of the minimal national requirements and also the additional requirements put forward by IGIC-BAS.

The total number of the noticed citations of all her publications amounts to 168 citations, as it is specified in the "Author's List of Verifications" of the candidate. It is stated that all the self-citations have been excluded and also the self-citations of all her co-authors and it is indicated that she has acquired **h-index 6 (Scopus)**. The candidate very carefully has represented beside the "The Total List of the Citations" also in addition a "List of Citations in Scientific Journals, included in the data base of Web of Science и Scopus", where it is indicated that there are 72 citations of this type of publications. It should also be pointed out that in the Group of Indices D - the Index 11 "Citations in scientific journals, referenced and indexed in data base Web of Science и Scopus" at minimal requirement of 60 points she has achieved a total of  $72 \times 2 = 144$  points, so with respect to this index also she considerably exceeds the requirements. What makes strong impression is the great number of 30 citations for the article in the outstanding well renowned journal Catalysis Today, and also in the other well established journal "Chemical Engineering Journal" - 15 citations. This shows the actuality of the researched thematics, the level of the contributions and the applicability of the obtained results.

## **2. Short biography data of the candidate**

Chief Assistant Ralitsa Velinova has graduated from the University of Chemical Technology and Metallurgy in Sofia in the year 2001 having the specialty profile "Technology of the Materials and Materials Science", specializing in the specific field of "Silicate Materials". She specialized at the University in the town of Aveiro in Portugal during the period 01.03.2001 - 31.07.2001 г. Then she started working in IGIC-BAS first as a chemist during the period 18.03.2008 - 22.11.2010 and later in the position of Chief Assistant

in the Laboratory “Analytical Chemistry” during the period 22.11.2010 - 16.10.2017 and thereafter in the same position as Chief Assistant in the Laboratory “Materials and Processes for Protection of the Environment”.

The topic of the PhD Thesis at the University of Chemical Technology and Metallurgy in Sofia was “Antique and Medieval Glasses in the Bulgarian Lands” and the defence took place on 30.03.2010. She is fluent both in English and Russian and in addition she has good experience in computer software (Windows, MS Office, Origin). She has participated in 10 national scientific research projects and 1 international scientific research project, a total of 89 participation in scientific events, out of which 61 international events and 28 national scientific events. She has considerable involvement in the education of young specialists - she had mentor activities in training 3 students, based on the Program “Students Practices - Phase 2”. She is member of the Union of Chemists in Bulgaria and also in the Association “Bulgarian Catalysis Society”. She was reviewer of publications in the journals Materials, Energies, Catalysts, Processes, Aerospace and Polymers.

### **3. Evaluation of the scientific research activities of the candidate**

- *Scientific publications:*

Considering the total number of 39 scientific research publications of Chief Assistant Velinova, out of which she submitted for participation in the competition procedure 17 papers, one can see that the publications have been evaluated in accordance with Web of Science and Scopus criteria. Among them I would point out as the most outstanding the publications in prestigious and well renowned journals of quartile Q1 - Chemical Engineering Journal, the two publications in Catalysis Today, Applied Catalysis A:General, Journal of Physical Chemistry C, and Nanomaterials. In the first place, as a specialist in kinetics, I would point out her contribution to the development of kinetic modeling and its role to draw conclusions about the mechanism of catalytic reactions – Reaction Kinetics, Mechanisms and Catalysis. This consideration should not be placed in the last place, in spite of the fact that this journal belongs to a lower quartile (Q3), as well as the publications, based on research work in international cooperation with some foreign scientists of France and Romania, which enabled access of the candidate to scientific equipment, which is not available here. The elaboration of catalysts for complete oxidation of hydrocarbons - alkanes and toluene, as well as the oxidation of volatile organic compounds is of great importance for the protection of the environment and decrease in carbon-containing emissions. In this aspect I would underline the fact that the studied additives for modifying the catalyst samples, such

as for example metal oxides of nickel, cobalt, lanthanum, copper, manganese, tungsten and cerium enable preparing composites with lower expenses for their synthesis using easily accessible components and also in view of the price of the catalysts in comparison with the much more expensive palladium and platinum. The testing of the catalytic activities in monolithic reactors studying the kinetics of the oxidation reactions opens up a possibility for drawing conclusions about the mechanism of the catalytic reactions and conclusions about the scaling up of the catalytic reactors - this fact makes strong impression.

There are no claims from coauthors of the publications with respect to the participation of the candidate in the competition procedure. There is no other information about any incorrectness or about elements of plagiarism in the materials, submitted for participation in the procedure, which was confirmed by checking part of the main publications.

*Response in the current literature*

The total number of 168 noticed citations of the publications, represented for participation of Chief Assistant Velinova in the competition procedure at the date of submitting the documents - they are all referenced in Scopus and in Web of Science - this shows the significance of the research topic and the adequacy of the applied scientific research methodology. In this aspect I would like to lay the stress on the fact that the Hirsch Index(H=6) of the candidate, based on all her publications, will most probably grow up in the nearest future.

*Participation in national and in international scientific events:*

The candidate listed in her curriculum vitae a total number of 89 participations in scientific events, out of which 61 participations in international scientific events and 28 participations in national scientific events.

*Participation in scientific research projects, specializations*

Chief Assistant Velinova listed in her CV verification participation in research projects, a total number of 11 projects - 1 international project and 10 national projects. The basic activities of the candidate are focused towards investigation of the behaviour of heterogeneous catalysts in reactions of complete oxidation of volatile organic compounds. These activities have been accomplished applying a number of instrumental methods for the characterization and for estimation of the adsorption properties and also the oxidative-reduction properties of the synthesized catalyst samples.

In addition I would like to point out also her specialization in the University of Aveiro, Portugal during the period 01.03.2001 - 31.07.2001, where she acquired valuable experience and knowledge on technologies for silicate materials and materials science.

#### **4. Scientific research contributions and their applicability**

##### *Scientific research contributions*

The main directions of the contributions of the candidate can be divided in groups in several aspects. In the first place these are the catalysts based on oxides of transition metals, supported on porous materials and also bulk phase catalysts. The second direction is focused towards catalysts based on Pd and Pt as active components, which are supported on carriers such as alumina, tungsten oxides, Ti-SBA-15 and mordenite.

The first direction includes the synthesis of catalyst samples  $\text{Co}_3\text{O}_4\text{-MnO}_x$ , supported on various carriers - such as SBA-15, as well as hierarchical macro-meso-porous  $\text{SiO}_2$ . Here the main contributions are correlating the measured catalytic activity to the contribution of the separate components and the respective oxygen-containing species, observed on the surface, the mobility of the oxygen in the crystal lattice. On this basis a convincing explanation is given for the reasons of the highest catalytic activity of specific samples. It should be added also the respective contributions of the other samples - Co-Ce oxides, supported on SBA-15, as well as the bulk phase catalysts, based on  $\text{MnCoFeO}_4$ . A logical explanation is proposed about the experimentally observed lower catalytic activity of the bicomponent samples compared to the single component samples, based on the fine dispersion of Co and Ce oxides and their strong interaction inside the channels of SBA-15, leading to the formation of hardly reducible oxide phases.

The second direction in the field of heterogeneous catalysis, which is focused on the catalysts based on Pd and Pt, supported on  $\text{Al}_2\text{O}_3$ , Ti-SBA-15 and mordenite, one can distinguish the following contributions. Increase in the capacity of the synthesized catalyst samples is achieved for storage of reactive oxygen and also lowering of the temperature of oxidation of the organic compounds, which is achieved by promoting the reducibility of the metal oxide of the support. An important aspect, which makes strong impression, is the established decrease in the activation energy for the reactions of catalytic oxidation of alkanes upon increase in the length of the carbon chains of the alkanes C1 - C4 i.e. from methane to butane. The authors have found out, that this effect is connected with the lowering of the dissociation energy of the weakest bond C-H in the respective hydrocarbon. Another substantial contribution is the comparative study Pd-containing samples, juxtaposed with the

samples of pure  $\text{CaWO}_4$ , whereupon it was established, that the  $\text{Pd}/\text{CaWO}_4$  samples has much higher ability to adsorb oxygen on its surface. This fact in its turn leads to significant lowering of the reaction temperature. In the specific case of toluene oxidation reaction it should be noted, that this is achieved in laboratory at much higher space velocity of the reagents in comparison with that in industrial processes. In this aspect it should not be omitted also the established absence of any considerable difference in the medium size of Pd particles during prolonged operation of 96 hours - this illustrates the high stability of the obtained catalyst sample, which helps to a great extent to preserve the higher reducibility of the metal oxide of the support.

Some other also important contributions concern the elucidation of the role of other different additives of Co, La, Ce, Ni and various types of supports - tungsten oxides, Ti-SBA-15,  $\text{Al}_2\text{O}_3$ , mordenite, which reveals the wide scope of the studies and this without any doubt has resulted in successful mastering of a large number of various analytical methods and high level of development of the candidate as scientific expert in this field of competence and mostly the methods of synthesis of catalyst samples having different micro-porous structure, as well as the methods of testing the catalytic activity. This entire variety of factors determines the wide scope of her investigations, involving multiple methods for characterizing the prepared catalyst samples and all these give us an idea for the complicated picture, gradually elucidated during the process of these complex investigations. All these methods, considered in their complex variety, have developed the candidate as a multilaterally developed specialist. What is visible - this is the systematic renewal of the topics and directing the research to some new modern aspects of applicability.

*Expert activities:*

The expert activities of Chief Assistant Velinova are manifested in her reviewing of articles in prestigious international journals such as Materials, Energies, Catalysts, Processes, Aerospace and Polymers. She was a guest-editor in the special issue of "Catalytic Combustion - from Laboratory Tests to Practical Applications" of the journal "Catalysts" (MDPI) - all this illustrates the level of competence, achieved by her. She is a member of the association "Bulgarian Catalysis Society" in her quality of researcher in this field, whereupon she acquired her level of expertise. Beside this she is also a member of the Union of Chemists in Bulgaria. She was mentor of students in the educational program "Students practices", she organized visits of school children, she participated in the meeting "Science for business" 3, which illustrates the application aspect of her research activities.

The professional skills and level of expertise of Chief Assistant Velinova, her qualities and the ability for team work have been confirmed during my contacts with other colleagues in IGIC-BAS and IC - BAS. I have not any joint participation in fulfillment of scientific research projects with her. I have no publications in co-authorship with Velinova and my opinion with respect to her participation in this competition procedure is based entirely on the materials and documents, submitted to me.

### **5. Evaluation of the personal contribution of the candidate**

All research publications of Chief Assistant Velinova, represented for her participation in this competition procedure for occupying the academic position of „Associated Professor” at IGIC – BAS, are results from her joint team work together with her colleagues. It is difficult for me to distinguish specifically her personal contribution as experimentator or in the processing of the experimental data and interpretation of the obtained results – most probably she has significant contribution in all of these three aspects.

### **CONCLUSION**

The documents and the materials, submitted by Chief Assistant Velinova, are in complete accordance with all the requirements of the Law for the Development of the Academic Staff in the Republic of Bulgaria (LDASRB), the Regulations for the application of the LDASRB and the respective Regulations of BAS, as well as the specific requirements of IGIC – BAS. The candidate has represented a sufficient number of her research papers, published after the materials, used in her defending the PhD Thesis and for occupying the academic position Chief Assistant. There are original scientific contributions in the submitted papers, whereupon the basic part of them have been published in journals having impact factor, issued by prestigious international academic publishers. All these facts give me the reason to express my positive opinion and to be convinced to recommend to the members of the Scientific Jury to vote „YES” and to prepare a joint report-proposal to the Scientific Council of IGIC-BAS to appoint Chief Assistant Velinova to occupy the academic position „Associated Professor" at IGIC-BAS in the professional direction 4.2 „Chemical Sciences", scientific speciality „Chemical Kinetics and Catalysis".

15.09.2023

**Reviewer:**.....

(Prof. PhD Alexander Eliyas)