

OPINION OF REVIEWER

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In regard to the competition for occupying of the academic position „Professor" at the
Institute of General and Inorganic Chemistry - BAS

I was appointed as member of a scientific jury by written order № ПД-09-80 dated 1 July 2019 issued by the Director of the Institute of General and Inorganic Chemistry (IGIC) - BAS, in connection with the competition for occupying of the academic position „Professor" announced by IGIC- BAS in professional field 4.2 „Chemical Sciences", scientific specialty „Chemical Kinetics and Catalysis ", for the needs of the Laboratory „Reactivity of Solid Surfaces“ at IGIC published in „Official Gazette“ issue 36 dated 03.05.2019 based on the decision of the Scientific Council for General and Inorganic Chemistry (Record of Minutes № 9/27.06.2019). On 10.07.2019 the members of the jury had a meeting and it was decided that I should submit my opinion as reviewer – I was given the „Regulations for the conditions and order for occupying academic positions at IGIC - BAS“, as well as a CD, containing respectively all the necessary documents: a copy of the announcement in „OG“, Curriculum Vitae of the only candidate, certificate for length of service exceeding the required minimum of 5 years length of service in the academic position of associated professor, list of all the publications and a separate list of the specific publications for participation in the competition.

1. General presentation of the submitted materials

The only candidate in the competition for occupying of the academic position „Professor", announced in OG, issue 36 of 03.05.2019, and on the web site of IGIC-BAS is the Associated Professor PhD Mihail Yordanov Mihailov. The set of materials, submitted by him, are in correspondence with Article 29 of the Law for Development of the Academic Staff in the Republic of Bulgaria, Articles 31 and 32(1) of „Regulations for the conditions and order for acquiring research degrees and occupying academic positions at BAS“ and Articles 55(1) and 58(1) of the „Regulations for the conditions and order for acquiring research degrees and occupying academic positions at IGIC-BAS“. His diploma for acquiring the educational and research degrees „PhD” dated 2003 bares the code 01.05.16 „Chemical Kinetics and Catalysis", which coincides with the announced scientific specialty of the

competition. The topic of the PhD Thesis was „Synthesis and characterization of supported dispersed nickel catalysts – influence of the support on the properties of nickel” – as one can see there is adequate correspondence in this aspect too.

The candidate has a total of 71 research publications, out of which for participation in the competition the candidate has put forward as habilitation work 5 scientific research publications of quartile Q1 giving each one 25 points making a total of 125 points (Group of indices B, item 4). In separate in Group of indices G he has listed some other 18 scientific research publications of Q1 quartile amounting to a total of 450 points. The candidate has put forward an impressive total of 1600 citations of his publications, out of which after the habilitation he has 1500 citations on all scientific publications (including his papers from the habilitation thesis). Among them are 387 citations of the publications, submitted for participation in the competition (Index D) in scientific research journals referenced and indexed in Web of Science and Scopus amounting to a total of 774 points.

Lecturing and training activities

As far as it concerns his activities in the education and training of staff – he was co-mentor in the training of two PhD students and in addition to it he consulted one more PhD student.

2. Short biography data of the candidate

Assoc. Prof. Mihaylov graduated from the University of Sofia „St. Clement of Ohrid” in the year 1997 in the specialty „Inorganic and Analytical Chemistry”. His PhD Thesis for acquiring the educational and scientific degree „Philosophy Doctor” is in correspondence with the topic and the respective code of the announced competition for occupying of the academic position. After his successful defense procedure he occupied the position of assistant during the period 2003 -2008 at the Institute of General and Inorganic Chemistry-BAS and in 2008 he was successful in the habilitation procedure and he became Associated Professor in IGIC-BAS. He has the required proficiency in English, Russian and German languages.

3. Estimation of the scientific research and application activities of candidate

- *Scientific research papers:*

Considering the distribution of the total number of scientific publications of Assoc. Prof. Mihaylov, amounting to a total of 71 research papers, one can see that 62 of these papers have been published in journals having impact factor, 2 of the publications are in journals having no impact factor, 2 book chapters and 5 other publications appeared as conference proceedings.

To the best of my knowledge there are no claims put forward by his co-authors in their common publications in regard to the papers presented by the candidate for participation in the competition. There is no other information available about any incorrectness or about elements of plagiarism in the materials put forward for participation in the competition, which fact has been confirmed by checking the major part of his basic publications.

Response in the current scientific research literature

The total number of noticed citations of the publications, represented for the participation of Assoc. Prof. Mihaylov in the competition, amounts to 387 citations at the date of submitting his documents and they are all either in Scopus or in Web of Science, while the Hirsch index of the candidate (h-index) is impressively high $H=21$ giving a total of 210 points, exceeding the required minimum of 120 points. This is an additional requirement put forward by IGIC, put forward in the group of indices Ж items 21-29.

- *Participation in national and international scientific events:*

During the period of the competition scientific research works involving the participation of Assoc. Prof. Mihaylov have been presented in 40 scientific events, out of which 29 were international scientific events and other 11 presentations at national scientific events. My opinion as catalysis researcher – I would list in the first position his participations in the 9-th and 10-th European Congress on Catalysis, as well as taking into account the announced theme of the competition. He has also a large number of participations in conferences, devoted to porous materials and their applications, among which also in catalytic reactions, and not only as adsorbent materials. One can outline the topic Metal Organic Frameworks (MOF), which is generally considered to be very modern research direction in recent times. The distribution of the listed participations - 14 are oral presentations, as well as a plenary lecture.

4. Scientific and applied scientific research contributions

- *Scientific contributions*

The basic part of the contributions of the candidate is connected with the use, but not only the use, but also with the development of the method of infrared spectroscopy to gain information having fundamental importance. This means obtaining data about the chemistry of the solid surfaces of adsorbents and catalysts and respectively the processes and interactions not only with inorganic compounds, but also with some organic gases and vapors. It is of great importance for the science of catalysis to establish the nature of the compounds formed on the surface by adsorption or reaction, aiming at the elucidation of the number of the intermediate compounds being formed on the surface, and this number corresponds to the number of elementary steps of the occurring catalytic reaction. This information would be very useful and it could serve as the basis for modeling the kinetics of the catalytic processes and for the defining of the so called “mechanistic kinetic models” – superior knowledge, comparing with the so called empirical kinetic models. This is my recommendation for a possible future direction of research extending the present scope of his research efforts.

What makes impression is the great number of analytical methods that the candidate is has been using: X-ray diffraction phase analysis, X-ray photoelectron spectroscopy, temperature-programmed reduction, electron paramagnetic resonance, electron microscopy, UV-spectroscopy, methods for testing the catalytic activity, theoretical modeling – all these methods, considered as a combination, undoubtedly have trained and educated a high level of multilateral specialist.

He paid special attention to the field of metal-organic structures, which is modern research direction – he has submitted 9 publications on this hot topic of the day. The MOF materials have been synthesized in collaboration with partnering universities in Western Europe, which is a very useful partnership. The importance of IRS measurements of Bronstedt acidic sites, as well as Lewis acidic sites, originates from the fact that, half of the catalytic reactions are occurring through acid-base interaction mechanism. As far as the other half of the catalytic processes is concerned – those processes occurring through reduction-oxidation mechanism – here also the candidate has substantial contribution in regard to clarifying the action of the redox ion pair i.e. the $\text{Ce}^{3+}/\text{Ce}^{4+}$ ion couple.

The candidate has submitted two information data files as an author – about the character of his contributions in the presented publications, put forward for participation in the competition for the position of professor, and the second one

concerns the information about his contributions of his habilitation works. One can observe that the main attention in his efforts has been directed to IRS investigations on the adsorbed species of NO_x and CO_x upon CeO₂. What makes a strong impression is the fact that the studies, carried out by Assoc. Prof. Mihaylov have resulted in reconsidering and revising the concepts existing so far. This proves the significance of the IRS method and the application of isotopic labeling of molecules and measuring the respective isotopic shift, which appears to be the criterion giving difference in the stretching vibrations. In this way some fundamental information has been obtained about the existence of some new intermediate compounds. It is this fact that led to reconsidering and revision of the existing concepts about the mechanism and it opens up a possibility to design catalysts and adsorbents and achieving some desired selectivity.

Participation in basic research and applied research contracts and projects:

With respect to the group of indices E I would like to point out as most significant the following research contracts: BYX 303 (2007-2011) on zeolites having potential application in catalysis under the guidance of Prof. Vaysilov, the contract ДО 02-28 (2009-2010) focused on the topic of the role of gold cluster particles in environmental catalysis under the guidance of BAS Corr. Member HadjiIvanov, the contract ДО 02-184 (2009-2013) about new materials having catalytic properties –again under the guidance of BAS Corr. Member HadjiIvanov. It should also be pointed out the active participation of the candidate in the two Centers of Excellence devoted to new materials UNION and UNION-2 during the period 2009-2013. It is of no less importance to mention the newer projects with the Ministry of Education (2014-2017) and the National Science Fund (2017-2020) on metal-organic structures. The candidate is involved also in the activities of the National Center of Mechatronics and Clean Technologies, comprising the period 2018-2023, as well as another project in line with Erasmus+ of the national program „Low-carbon energy for transportation and household needs”.

Assoc.Prof. Mihaylov has been the leader of two contracts ДО 02-290 (2010-2012) and also T 02-20 (2014-2016) – as one can observe this is a quite intensive scientific research activity and the financial resources, obtained on the basis of these two contracts are considerable – respectively 202 500 BG leva and 195 000 BG leva, which enabled the opportunity to accomplish some very expensive isotopic investigations.

Expert activities:

The expert activities of Assoc.Prof. Mihaylov comprise his opinions as reviewer of manuscripts in prestigious international journals and probably also as reviewer of PhD degree, however this information is missing in the data files, submitted by the candidate – so this omission is in fact my critical remark, however this information is not obligatorily required in the Regulations – it is optional, depending on the decision of the candidate.

The professional skills and expertise of Assoc. Prof. Mihaylov, his qualities and abilities when working in a team were confirmed in my occasional personal contacts with him and also by my colleagues at the Institute of Catalysis - BAS, although I have never had any joint participation with him fulfilling together a research project. The Institute of Catalysis fulfilled together with the Institute of General and Inorganic Chemistry a project of the Operating Program Development of Human Resources of the European Union and we had occasional contacts – me and my colleagues with Assoc. Prof. Mihaylov.

5. Evaluation of the personal contribution of the candidate

All the scientific research publications of Assoc. Prof. Mihaylov, submitted for his participation in the competition for occupying the academic position of professor at IGIC-BAS, are the result of his teamwork, together with the involvement of his colleagues at IGIC and some foreign partners, so it is difficult to distinguish his personal contributions as experimenter or in the processing of the data and interpretation of the results – most probably he has considerable contribution in all these stages and aspects.

CONCLUSION

The documents and the materials, submitted by Assoc. Prof. Mihaylov, are in complete correspondence 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 LDASRB in Official Gazette and the corresponding Regulations of BAS, as well as the specific requirements, formulated by the Institute of General and Inorganic Chemistry at BAS. The candidate has presented a sufficient number of scientific research publications, published after the materials, used in the defense procedure for acquiring the educational and scientific PhD degree „доктор" and later in the procedure for occupying the academic position of Associated Professor. In the newly represented scientific research works one can observe without a doubt considerable research contributions, whereupon the basic part of them have been published in journals of high impact factor, issued by prestigious international academic publishers. All these facts give me the reasons to submit my positive estimate, so I

am quite convinced to recommend to the members of the Scientific Jury to vote YES and to prepare a report of the jury procedures, containing proposition to the Scientific Council of the Institute of General and Inorganic Chemistry - BAS to appoint Associated Professor Mihail Myhaylov to occupy the academic position Full Professor in IGIC-BAS in the professional field 4.2 „Chemical Sciences", scientific specialty „Chemical Kinetics and Catalysis".

26.08.2019

Signature of reviewer:.....

(Prof. Alexander Eliyas PhD)