O P I N I O N OF R E V I E W E R

from Prof. Zara Cherkezova-Zheleva, Institute of Catalysis - Bulgarian Academy of Sciences (member of the Scientific Jury)

on the competition for occupying the academic position **professor** in the professional field 4.2. "Chemical sciences", scientific specialty "Solid State Chemistry" for the needs of the Institute of Catalysis at the Bulgarian Academy of Sciences, Laboratory "Design and Characterization of Catalytic Materials" - "Synthesis and Structure of Catalysts and Sorbents",

announced in the State Gazette 82/07.10.2025

According to the Order № РД-09-92/09.12.2025, issued by the Director of the Institute of Catalysis, BAS (IC-BAS), I was appointed as a member of the Scientific Jury for accomplishing the procedure in the competition for occupation of the academic position „professor" in IC-BAS in the professional field 4.2 „Chemical Sciences", scientific research area „Solid State Chemistry", for the needs of the Laboratory "Design and Characterization of Catalytic Materials" - "Synthesis and Structure of Catalysts and Sorbents" in IC-BAS announced in the State Gazette 82/07.10.2025.

1. Attitude on the obtained materials:

Assoc. Prof. PhD Nikolay Ivanov Velinov is the only candidate, applying for the academic position “Professor” in the competition, announced by the IC-BAS for the needs of the Laboratory "Design and Characterization of Catalytic Materials". He has submitted a full set of application documents according to the requirements of the Regulation for the Terms and Procedure for Acquisition of Academic Degrees and for Occupation of Academic Positions in the Institute of Catalysis of BAS. Assoc. Prof. PhD Nikolay Velinov fulfils all the relevant law requirements for occupation of the academic position “Professor”. He has submitted 27 research publications for the competition, published after receiving of PhD degree and Assoc. Prof. academic position. These 27 publications are an object of the current review. Based on the relevant summary submitted by the applicant it is obvious that he fulfils and even exceeds both minimal National requirements and the specific requirements of IC, BAS. It should be noted that his score for group Д, Г, Ж, Е and В indicators is far above the relevant requirements.

2. Short biographical data about the applicant:

Assoc. Prof. PhD Nikolay Velinov graduated in 2001 from the University of Chemical Technology and Metallurgy, Sofia as a chemical engineer with a degree in "Materials Technology and Materials Science”, specialization "Silicate Materials". In the same year, he had a 6-month specialization at the University of Patras, Greece. In 2009, he obtained the educational and scientific degree "PhD" from the University of Chemical Technology and Metallurgy, Sofia, in the scientific specialty 02.10.12: "Technology of Silicates, Binders and Refractory Non-Metallic Materials", under the supervision of Prof. Dr. Vladimir Kozhuharov with a thesis on the topic: "Synthesis and Study of Perovskite and Perovskite-Like Structure for Cathodes in Solid Oxide Fuel Cells".

In 2010, Dr. Nikolay Velinov won a competition for a senior assistant at the Institute of Catalysis - BAS in the specialty 01.05.18 (Solid State Chemistry) and worked on this position until 2014. In the same year, he was elected as an Associate Professor at the IC-BAS in this specialty and currently works in the same position. As of 21.11.2025, he has an

internship in the specialty, which exceeds the requirement in the regulatory documents for the competition for the academic position of "professor" at the IC-BAS. The candidate is a member of the International Board on Applications of the Mössbauer Effect (IBAME) since 2023, as well as a member of the Bulgarian Catalytic and EPR Society. He was a consultant on 1 PhD thesis and 4 diploma theses.

3. Analysis of the scientific and innovative activities of the candidate

Scientific research publications:

Assoc. Prof. PhD Nikolay Velinov submitted 27 publications in total for participation in the competition, which have been published in peer-reviewed editions. All these editions have been refereed by Scopus / Web of Science. There is no evidence of plagiarism in all presented scientific works. The publications submitted for participation in the competition do not duplicate the ones presented for obtaining a PhD degree and Assoc. Prof. academic position. It should be noted that Dr. Velinov is the first, second or third author, respectively, in 22% (6 out of 27), 22% (6 out of 27) and 15% (4 out of 27) of the titles, and in the remaining 41% (11 out of 27) publications he is the next author. This shows a leading contribution to the development of the presented scientific works and their related contributions. The results of the candidate's research activities have been published in established international journals with an impact factor (IF) and impact rank (SJR), including: Acta Metallurgica Sinica (IF 1.88), Microporous and Mesoporous Materials (IF 3.349), Materials Research Bulletin (IF 0.746), Hyperfine Interactions (IF 0.487), Applied Catalysis B (IF 8.328), Applied Surface Science (IF 10.383), Carbon (IF 10.9), et al. 9 of these publications are in area Q1, 5 - in area Q2, 6 - in area Q3 and 7 - in area Q4 (WoS or Scopus).

The publications participating in the competition were divided into two groups, covering the B and Г indicators, according to the Rules of the conditions and order for acquiring academic degrees and for taking up academic positions at the IC - BAS. In the first group, indicator B - "Habilitation thesis - scientific publications in journals that are referenced and indexed in world-famous scientific information databases (WoS or Scopus)" are presented 9 publications, with the points received exceeding the required 100 points for this indicator. 2 of these articles (22%) are in journals in the Q1 area, 2 publications (22%) are in journals in the Q2 area, 3 (33%) are in journals in the Q3 area, and the other 2 publications (22%) are in the Q4 area (WoS or Scopus). An indicator of the candidate's leading role in the development of the submitted scientific works and the related contributions is given by the distribution of the authors in the team of these studies - in 67% (6 out of 9) of the publications he is the first author, and in the other 33% (3 out of 9) he is the second author. The second group presents 18 articles covering indicator Г-7, which exceed the required 220 points under indicator Г. These studies are distributed as follows: in 17% (3 out of 18) of the publications, Dr. Velinov is the second author, in 22% (4 out of 18) of the publications he is the third author, in 22% (3 out of 18) he is the fourth author, and in the remaining 44% (8 out of 18) he is the fifth or subsequent author.

Participation in national and international scientific events:

The results of Dr. Nikolay Velinov's scientific research have been presented at international and national scientific forums with over 45 participations as oral and poster reports. 6 (13%) of the poster communications were presented personally by the candidate, which has an undeniable contribution to his scientific development. Dr. Nikolay Velinov is a participant in the working team of 4 international and over 10 national projects. The candidate is the leader of the working group of 1 current national project, as well as 1 completed national project, which was awarded a certificate of the Bulgarian National Science Found for

a successfully implemented scientific project for 2023. The presented research and publications under this competition are closely related to the implementation of the relevant scientific projects. The materials presented under indicator E are sufficient to gain the required 150 points and even significantly exceed them.

International recognition and significance of the scientific results

An indicator of the significance of the scientific results of Dr. Nikolay Velinov's research is the large number of citations of his publications. A list with over 500 citations in the Scopus/Web of Science database is attached to 48 of the publications. With this, the candidate receives over 1000 points under indicator Д, which is more than 8 times higher than the required 120 points for the position of "professor" according to the Regulations on the terms and conditions for acquiring scientific degrees and for occupying academic positions in the IC - BAS (Appendix 1, Table 1). Assoc. Prof. Dr. Nikolay Velinov is registered in NACID (https://ras.nacid.bg/dissertation-preview/25506), where he is recognized for his PhD degree and the academic position of “Associated Professor".

In summary, it should be noted that according to the submitted materials on each of the indicators, the candidate for the current competition, Assoc. Prof. Dr. Nikolay Velinov, significantly exceeds the requirements set for candidates for the position of "professor" according to the Regulations on the conditions and procedure for acquiring scientific degrees and for occupying academic positions at the IC - BAS.

4. Contributions of the scientific and innovative research activities of the candidate

The main scientific contributions of Dr. Nikolay Velinov's fundamental and applied research are focused on the study of synthesis, structural characterization and catalytic properties of mixed ferrites containing Co, Zn, Mn, Ni, etc. elements, bulk and supported on various carriers such as activated carbon. The topic is actual and has great innovative potential. The practical application of the research is related to the development of new efficient and selective catalysts for chemical processes, for environmental protection and purification of polluted air or water. The candidate's research is related to the application of one of the most detailed methods for the characterization of iron-containing materials - Mössbauer spectroscopy at room temperature and low temperatures. The method provides precise information about the material structure, oxidation and coordination state of iron cations, phase transformations in a reduction or oxidition reaction environment and their relationship with the registered catalytic properties. The catalytic properties of the obtained ferrites were tested in the oxidation reactions of CO, methanol and dimethyl ether, decomposition of methanol to H_2 and CO, Water Gas Shift Reaction, etc. Estimation of the size of the ferrite crystallites was made by studying the values of the hyperfine magnetic fields in the materials. Phase composition and the associated catalytic activity and selectivity of these materials are considered as the result of complex transformations of the active phase under the influence of the reaction medium, which is closely related to the dispersity and localization of iron particles in the structure. Photocatalytic activity of ferrite materials in the decomposition of model pollutants in water (e.g. alizarin) under irradiation with visible and UV light was studied.

The **habilitation work** of Dr. Nikolay Velinov includes research related to the preparation, comparative studies and detailed characterization of complex Cu–M (M=Co, Zn, Mn, Ni) ferrites and ferrites supported on activated carbon. Mechanisms for control of cation distribution and phase transformations in ferrite materials have been established. The crystal

and electronic structure of these materials has been modified to optimize their catalytic properties. The research is consistent, and the results obtained have scientific and applied significance in the field of catalysis for hydrogen production and environmental protection.

The obtained research findings in the **first group of indicator B** - 9 publications (B1-B9), include the following scientific contributions:

- Preparation of mixed Cu–M ferrites with spinel structure using different synthesis methods such as mechanochemistry and self-ignition to control physicochemical properties;
- Establishment of dependencies between composition, structure and catalytic activity of the obtained materials in industrial and environmental catalytic reactions such as methanol decomposition, ethyl acetate oxidation, Water-Gas Shift Reaction;
- Modification of activated carbons obtained from agricultural wastes such as grape seeds, peach, apricot and olive pits, as carriers for the deposition of ferrite catalysts;
- Detailed study using Mössbauer spectroscopy of the formation of various active phases, such as magnetites, carbides, nitrides or metal alloys, depending on the reaction conditions;
- The possibilities of Mössbauer spectroscopy as a precise method for monitoring the structural changes of catalytically active iron-containing phases are shown.

The fundamental and applied research presented by the candidate in the **second group of indicator Г**, included 18 publications. The significant scientific and applied contributions of Dr. Velinov are related to:

- **Preparation of active catalysts based on Fe–Ce oxides [Г1, Г9, Г14, Г15]**

- Conditions for the formation of catalytically active sites in mesoporous Fe–Ce oxides have been established using an optimized hydrothermal method.
- A mechanism for improving the catalytic properties of materials by controlling phase composition and defectiveness has been proposed.
- Dependencies between physicochemical and functional properties of Fe–CeO_2 materials have been established, determining their catalytic activity in reactions such as NO reduction, methanol decomposition, and volatile organic compound oxidation.
- Au/Fe–CeO_2 catalysts with optimized composition for high activity and 100% selectivity to N_2 have been obtained.
- A synergistic effect between NiO and Fe–Ce oxides has been registered, which leads to higher activity and stability of the materials in methanol decomposition.
- Ni–Fe–CeO_2 metal–carbon nanocomposites with high electrocatalytic activity in the oxygen evolution reaction (OER) in alkaline medium have been obtained.

- **Preparation of catalysts based on Fe–Hf–Ti oxides [Г3, Г4]**

- The influence of Hf doping on the phase composition and dispersity of ferrite phases in the obtained Fe–Hf–Ti materials was registered
- Dependencies were found between physicochemical properties and catalytic behaviour of the samples in the oxidation of ethyl acetate, with the highest activity being shown by Fe–TiO_2 catalysts with a low Hf content.
- The obtained mesoporous TiO_2 and Hf–TiO_2 materials have a high specific surface area, and N-doping improves the absorption of visible light.
- It was registered that the presence of highly dispersed ferrite nanoparticles (with a size below 4 nm) and superparamagnetic behaviour leads to an increase in the catalytic activity in the reaction of complete oxidation of ethyl acetate, and the presence of metallic iron particles changes the selectivity in the methanol decomposition reaction to produce methane.

- **Preparation of catalysts supported on activated carbon [Г8, Г10, Г11, Г13, Г18]**

- The possibilities for optimizing the composition and structure of photocatalysts containing TiO_2/activated carbon (AC) composite materials with different TiO_2:AC ratios, by controlling the size of TiO_2 crystallites, the porous structure and the specific surface area have been established. The highest photocatalytic effect in the ultraviolet region is achieved at a composition of TiO_2:AC = 2:1.

- Conditions for obtaining carbon supports for catalytically active materials from different biomass precursors (e.g. cherry pits and walnut shells) have been established, which lead to different dispersity, phase composition and catalytic activity of the deposited ferrite nanoparticles in the catalytic decomposition of methanol.

- It has been registered that the texture and porosity of the activated carbon determine the formation of finely dispersed and catalytically active Zn–, Mn–, Ni– and Co–containing ferrites, and it has been established that in the obtained Ni–Zn–ferrites a synergistic effect between Ni and ZnO nanoparticles is observed and, accordingly, the highest catalytic activity.

- Carbon foams with controlled microporosity and surface functional groups have been obtained, which leads to increased catalytic activity in the selective decomposition of methanol by regulating the phase composition, morphology and redox properties of the deposited Co–Zn ferrite nanoparticles.

- It has been established that the pore topology of the used carbon precursor affects the physicochemical properties and catalytic behaviour of the deposited iron and chromium oxides, as the highest activity in methanol decomposition was registered when using mesoporous carbons.

- **Preparation of active catalysts based on ferrites [Г2, Г5, Г7, Г17]**

- Single-phase $La_{0.75}Sr_{0.25}(Fe_{0.8}Co_{0.2})_{1-x}Ga_xO_{3-\delta}$ materials with a perovskite structure have been synthesized and it has been shown that doping with Ga increases their catalytic activity and structural stability, and the supported Rh effectively activates methane during its partial oxidation to synthesis gas.

- It has been shown that mechanical grinding of $SrFe_{12}O_{19}$ hexaferrites leads to an improvement in their physicochemical and functional properties by increasing their activity in methanol decomposition, and the hexaferrite phase remains stable even under highly reducing conditions.

- The formation of catalytically active phases in Au-modified Cu–Mn ferrites with significant structural changes under the influence of reaction conditions has been registered, including partial reduction of the ferrite phase and alloying of Au and Cu, with the presence of metallic and magnetite phases determining the highest catalytic activity in Water-Gas Shift Reaction.

- It has been established that $MnCoFeO_4$ spinels with different textures can be obtained by the combustion method with different fuels, with the materials obtained with sucrose being characterized by a larger surface area, higher stability and a larger number of active centers, which makes them more active in low-temperature complete oxidation of hydrocarbons.

- **Study of iron-containing materials with Mössbauer spectroscopy [Г6, Г12, Г16]**

- It has been established that fayalite slag from the copper mining industry can be used as an effective geopolymer precursor, as its activation with phosphoric acid leads to formation of a stable inorganic polymer material with potential for application in construction.

- It has been proven that the catalytic behaviour of mesoporous Fe–Cr–SiO2 materials in the methanol decomposition reaction can be controlled by changing the Fe/Cr ratio and, as a result, the phase composition, redox properties and selectivity towards CO.

- Pure and Er-doped hematite nanorods have been obtained and the influence of replacing Fe^{3+} with Er^{3+} on changing the morphology, magnetic and optical properties of the samples has been registered, which allows controlling the functional characteristics of the materials.

5. Personal impressions of the reviewer about the candidate:

Based on the documents submitted in the competition and my personal impressions, I recognize Assoc. Prof. Dr. Nikolay Velinov as a leading researcher with a clear scientific focus. His research investigations are planned precisely and the obtained results are in-depth analyzed and interpreted adequately. The scientific contributions of his efforts are original and correct. They logically follow the obtained results and have a fundamental and applied nature, contributing to the realization of sustainable and green technologies.

6. Critical remarks and recommendations to the scientific works of the candidate:

Applicant's scientific papers submitted for participation in the competition are completely in the field of thematic area "Solid State Chemistry" and in particular are fully in line with the thematic area "Synthesis and Structure of Catalysts and Sorbents". The presented author's reference for the candidate's scientific contributions accurately reflects what has been achieved, and the results of the research activities of Assoc. Prof. Dr. Velinov are of scientific and applied contribution, mainly related to the preparation and study of iron-containing materials using the Mössbauer spectroscopy method to clarify the mechanisms of formation of catalytically active centers and other functional dependencies. I have no critical comments and recommendations for the candidate's scientific works.

CONCLUSION: Documents and materials presented by Assoc. Prof. Dr. Nikolay Ivanov Velinov meet all the requirements of the Law for the Development of the Academic Staff in the Republic of Bulgaria, the Regulations for its implementation and the corresponding rules for the implementation of the law in the IC - BAS. The candidate submitted a sufficient number of scientific papers, published after receiving the PhD degree and after the competition for the academic position "Associate Professor". The obtained results based on the research activity of Dr. Nikolay Velinov are original and have significant scientific contribution to the studied area. They completely fulfilled the relevant requirements of IC-BAS for occupation of the academic position "Professor" in the field of competition and are fare above them. I strongly support the application and also recommend to the members of the Scientific Jury and to the Scientific Council of the Institute of Catalysis-BAS to award to the Assoc. Prof. Dr. Nikolay Ivanov Velinov the academic position "Professor" under the direction 4.2. Chemical Sciences, "Solid State Chemistry".

07/02/2026
Sofia

Reviewer:

(Prof. Dr. Z. Cherkezova-Zheleva,
Member of the Scientific Jury)