R E V I E W

for the competition for the academic position of Professor
in Professional Field 4.2. Chemical Sciences**, scientific specialty** Solid State Chemistry**,**
for the purposes of the laboratory "Design and Characterization of Catalytic Materials"
within the thematic field "Synthesis and Structure of Catalysts and Sorbents"**,**
announced in the *State Gazette*, Issue No. 82 / 07.10.2025

Sole candidate: Assoc. Prof. Dr. Nikolay Ivanov Velinov

Reviewer: Ventzislav Rusanov Iankov, Prof. DSc,
Institute for Nuclear Research and Nuclear Energy – Bulgarian Academy of Sciences

1. General description of the submitted materials

For participation in the competition, the candidate has submitted, in electronic form, all twelve required groups of documents. In general terms, these materials fall within the thematic scope of **Solid State Chemistry**, specifically the synthesis and characterization of catalytic nanostructured materials. Without listing the submitted materials and documents in detail, I would like to emphasize that they are prepared with exceptional precision, and I consider the application of **Assoc. Prof. Dr. Nikolay Ivanov Velinov** to be highly suitable for appointment to the position within the subject area of the announced competition.

The candidate was born in 1978 in the town of Elin Pelin. He graduated from the **University of Chemical Technology and Metallurgy, Sofia**, obtaining an MSc degree as a chemical engineer in 2001. In 2009, he defended his PhD dissertation entitled *"Synthesis and Investigation of Materials with Perovskite and Perovskite-Like Structure for Cathodes in Solid Oxide Fuel Cells."* Since 2014, he has held the position of Associate Professor in the scientific specialty **Solid State Chemistry** at the **Institute of Catalysis – Bulgarian Academy of Sciences**.

2. Publications before and after the award of the scientific degree

The report indicates that the total number of the candidate's publications is **87**, of which **64** have been published in journals with an **Impact Factor (IF)** or **Scopus Impact Rank (SJR)**. The number

of **independent citations** is **573**. Based on an assessment using the **Scopus** database, with self-citations of all authors excluded, the **Hirsch index (h-index)** is **14**.

The candidate has participated in **9 international projects**, **19 national projects**, and **77 scientific conferences and forums**. The publications included in the materials submitted for the competition are new and do not overlap with those included in his doctoral dissertation.

The total number of publications submitted for evaluation in the competition is **29**, of which **9** are presented as a **habilitation work** (Indicator group **"B"**) and **18** are included in **Indicator group "G"**. All scientific publications submitted for participation in the competition have been published in journals refereed and indexed in internationally recognized scientific databases (**Web of Science** and **Scopus**) and were published after the candidate's appointment to the academic position of **Associate Professor**.

Part of the reported research was carried out within the framework of **4 international** and **19 national projects**, in which the candidate participated as a team member, serving as **project leader in two** of them.

3. General characteristics of the scientific and applied research activity

The scientific and applied research activity of the candidate is primarily associated with the selection, application, and modification of various synthesis methods for materials of interest to practical applications and industry, as well as with their characterization using a broad range of experimental techniques. These include **thermogravimetry**, **differential thermal analysis**, and **differential scanning calorimetry**, **X-ray diffraction analysis**, **transmission Mössbauer spectroscopy**, and the **conversion electron Mössbauer spectroscopy (CEMS)**, among others.

Three main groups of materials have been investigated:

1. **Mixed oxides with perovskite and perovskite-like structures**;
2. **Nanosized ferrites with spinel structure**;
3. **Nanosized heterogeneous catalysts**.

4. General characteristics of the teaching activity

The teaching activity of the candidate includes work with undergraduate and graduate students, as well as PhD students, at the **Institute of Catalysis, Bulgarian Academy of Sciences**. The candidate has conducted **practical classes** in the courses *"Glassy Materials"* and *"High-Temperature Synthesis Methods"* within undergraduate programs at the **University of Chemical Technology and Metallurgy (UCTM)**.

In total, he has supervised **four diploma theses**, one of which was a **Master's thesis** defended at the department where **Prof. Mitov** was teaching. He has also supervised **one PhD dissertation** (*K. Koleva, "Synthesis and Characterization of Mixed-Oxide Materials for Catalysts in the Methanol Decomposition Reaction," 2016*).

Upon my recommendation, he has been a **Bulgarian representative member** of the **International Board on the Applications of the Mössbauer Effect (IBAME)** since **2023**. He is a member of the **Bulgarian Catalysis Society** and the **Bulgarian EPR Society**.

5. Main scientific and applied contributions

With regard to the investigation and synthesis of materials with **perovskite and perovskite-like structures**, a major contribution consists in the identification and confirmation of the advantages of **liquid-phase synthesis methods** over conventional **solid-state methods**. The possibility for **precise control of the stoichiometry** of the synthesized mixed oxides has been demonstrated, enabling the preparation of **single-phase materials** with accurately defined and complex compositions, synthesis at temperatures several hundred degrees lower than those required by conventional ceramic methods, and the production of oxide materials with a **high degree of homogenization**. The applicability of these materials in **fuel cell systems** has also been evaluated.

With respect to studies on **nanosized ferrites with spinel structure**, particular emphasis should be placed on the demonstrated possibility for the **direct application of mechanochemical activation**, as well as **thermochemical treatment of co-precipitated precursors**, for the preparation of highly efficient **iron-containing heterogeneous catalysts**. For the first time, **complete mechanosynthesis** of catalytically important chemical systems with complex stoichiometry has been achieved. A particularly significant contribution is the establishment of **correlations between spectral**

parameters or structure, on the one hand, and catalytic activity and selectivity, on the other, enabling the **prediction of catalytic performance**.

A similar contribution is evident in the studies of **nanosized heterogeneous catalysts**, where the main results concern the determination of the **composition, stoichiometry, and structure** of heterogeneous catalysts as a function of the specific synthesis method and their behavior in **bulk and supported forms**. At this point, I would like to emphasize the **exceptionally high quality of the Mössbauer spectra**, their processing and interpretation, as well as the appropriate **combination of complementary experimental methods**, which enables comprehensive characterization of the investigated materials. Particularly high merit should be attributed to the use of the **conversion electron Mössbauer spectroscopy (CEMS)** technique, which provides information exclusively from the **surface layer**, i.e., the **catalytically active layer**.

Ferrites with **spinel-type structure** are materials of considerable practical importance. At present, a highly topical research direction with both scientific and practical relevance is the investigation of ferrite materials as catalysts for **environmentally important processes**. **Binary and ternary metal oxide systems** are effective catalysts in a number of industrial processes, such as **oxidative dehydrogenation of hydrocarbons**, **alcohol decomposition**, **alkylation reactions**, **Fischer–Tropsch synthesis**, and **oxidation of harmful organic gases**. The functional properties of spinel ferrite materials largely depend on the **distribution of metal cations** within the structure. According to their cation distribution, spinels are classified as **normal, inverse, and partially inverse**. The physical, chemical, and catalytic properties of spinels are a direct function of the **chemical nature of the metal ions**, their **oxidation state**, **symmetry**, and **nearest and next-nearest coordination environment**. The development of effective heterogeneous catalysts with high activity, selectivity, chemical and thermal stability requires a **comprehensive investigation of composition–structure–property relationships** in catalytic materials.

The report summarizes scientific results published during the period **2015–2021**, presented in **nine papers** from **Indicator group "B" [B1–B9]**, published in international peer-reviewed journals indexed in **Web of Science / Scopus**. These works focus on the **synthesis, structural characterization, and catalytic properties** of mixed ferrites containing **Co, Zn, Mn, and Ni**, ferrites supported on **activated carbon**, and **oxide–nitride systems**.

The papers were published in well-established international journals with **Impact Factor (IF)** and **Scimago Journal Rank (SJR)**, covering quartiles from **Q1 to Q4**, including *Acta Metallurgica Sinica* (Q1), *Microporous and Mesoporous Materials* (Q1), and *Materials Research Bulletin* (Q2). Six of the papers were published in journals of **Springer Nature** and **Elsevier**. The selected publications included in **Indicator group "B"** present comprehensive experimental studies in which **Assoc. Prof. N. Velinov** is the leading author or co-author, focusing on the **targeted modification of the crystal and electronic structure** of **Cu–M (M = Co, Zn, Mn, Ni) ferrites** and ferrites supported on activated carbon, with the aim of **optimizing catalytic properties**.

The main scientific results reported in the publications included in **Indicator group "B"** comprise:

- establishment of **phase–structure relationships** in mixed spinel **Cu–M ferrites**, controlled by **mechanochemical** and **self-combustion** synthesis methods;
- identification of **composition–structure–activity relationships** in a number of catalytic reactions (methanol decomposition, ethyl acetate oxidation, **WGSR**);
- introduction of **modified carbons derived from agricultural waste** as supports for ferrite catalyst deposition;
- evidence for the formation of **specific active phases** (magnetites, carbides, alloys, nitrides) demonstrated by **Mössbauer spectroscopy**;
- implementation of **Mössbauer spectroscopy** as a tool for monitoring **structural transformations** in catalytically active ferrite phases.

The presented publications demonstrate a **systematic research progression**, encompassing the development of synthesis methods, mechanisms for controlling cation distribution, and phase transformations in ferrite systems. The results possess both **theoretical and applied significance** in the field of catalysis for **hydrogen production** and **environmental protection**.

In a second report on the scientific works submitted under **Indicator group "G"**, the publications are classified into several main research directions:

1. **Fe–Ce oxide-based catalysts** [G1, G9, G14, G15];
2. **Fe–Hf–Ti oxide-based catalysts** [G3, G4];
3. **Activated carbon-supported catalysts** [G8, G10, G11, G13, G18];
4. **Ferrite-based catalysts** [G2, G5, G7, G17];

5. **Studies on iron-containing materials** [G6, G12, G16].

Summarized contributions:

- The feasibility of utilizing **fayalite slag from the copper smelting industry** as an effective **geopolymer precursor** has been demonstrated, showing that activation with **phosphoric acid** leads to the formation of a stable **inorganic polymer material** with potential applications in construction.
- It has been shown that the catalytic behavior of **mesoporous Fe–Cr–SiO_2 materials** in methanol decomposition can be controlled by varying the **Fe/Cr ratio**, which governs phase composition, redox properties, and **CO selectivity**.
- **Pure and Er-doped hematite nanotubes** have been synthesized, and it has been demonstrated that **Er^{3+} substitution** systematically alters morphology, magnetic and optical properties, including a reduction of the **hyperfine magnetic field** and the **Morin transition temperature**, enabling targeted tuning of hematite functional characteristics.
- **Total number of publications under Indicator group "G"**: 18 (340 points)
    - Q1: 7 × 25 = 175 points
    - Q2: 3 × 20 = 60 points
    - Q3: 3 × 15 = 45 points
    - Q4: 5 × 12 = 60 points

Table 1 presents the minimum required scores by groups of indicators and their fulfillment by Assoc. Prof. N. Velinov in the competition for the academic position of Professor.

Indicator group	Content	Minimum required points for Professor	Points achieved by Assoc. Prof. N. Velinov
A	Indicator 1	50	**50**
B	Indicator 2	–	–
B	Indicators 3 or 4	100	**159**
G	Sum of indicators 5 to 10	220	**340**
D	Indicator 11	120	**1078**
E	Sum of indicators 12 to the end	150	**350**

6. Impact of the scientific publications in national and international literature

As already noted, the total number of identified **independent citations** is **573**. Based on my assessment using the **Scopus** database, the **Hirsch index (h-index)** of the candidate is **14**.

7. Contribution of the candidate in co-authored publications

The publications in which **Assoc. Prof. Velinov** has participated involve a relatively small number of co-authors, ranging from **three to ten**, typically **five to seven**. Considering the specific nature of the conducted research—namely, the **synthesis and characterization of materials using a series of experimental techniques**—I believe that the candidate's contribution is, in all cases, **clearly identifiable and relatively easy to substantiate**. It is evident that his main contribution is primarily related to the **acquisition, processing, and interpretation of Mössbauer spectral data**.

8. Critical remarks on the submitted works

I have **no significant remarks** regarding the submitted works and materials.

9. Personal impressions of the candidate

I have known **Nikolay Velinov** for many years. My general impression, formed already a long time ago, is that of a **highly motivated and creatively active scientist** who conducts his research work **systematically and in depth**, even under the challenging conditions of the Bulgarian research environment. This impression has remained unchanged to the present day. I also have very positive impressions of his **responsible and reliable work in a research team**.

Through my participation in numerous evaluation committees, reviews, and expert panels—related not only to him but also to many members of the research group—I have gained extensive insight into his professional activity. We have a substantial number of **joint publications and scientific collaborations**. I would also like to highlight his **active involvement, including maintenance and technical support**, in the **Mössbauer spectroscopy laboratory**, which he currently leads. Recently, the laboratory acquired **new and unique instrumentation**, which **Assoc. Prof. Velinov successfully commissioned independently**.

10. Conclusion

The conducted review and analysis of the overall scientific and research activity of **Assoc. Prof. Dr. Nikolay Ivanov Velinov** demonstrate that the candidate fully meets all formal requirements and **meets and exceeds the recommended criteria** of the **Scientific Council of the Institute of Catalysis, Bulgarian Academy of Sciences**, for appointment to the academic position of **Professor**.

I therefore **confidently recommend** to the **Scientific Jury** and to the **Scientific Council of the Institute of Catalysis** that **Assoc. Prof. Dr. Nikolay Ivanov Velinov** be **elected and appointed** to the academic position of **Professor**. At the final meeting of the Scientific Jury, I will vote **"IN FAVOR."**

30 January 2026

Sofia

Reviewer:

(Prof. DSc Ventzislav Rusanov Iankov)