Институт по ФИЗИКОХИМИЯ при БАН
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REVIEW

on the competition for the academic position of "Associate Professor"
announced in the State Gazette No. 63 of 10 July 2026,
in professional field 4.2. Chemical Sciences, scientific specialty "Physical Chemistry"

Candidate: Chief Assistant Dr. Nikolay Bozhidarov Yordanov

Reviewer: Prof. Dr. Dragomir Mladenov Tatchev

1. General information and brief biographical data of the candidate

Nikolay Bozhidarov Yordanov is a chemical engineer holding a Master's degree in Chemical Technologies with a specialization in the technology of organic synthesis. He graduated from the University of Chemical Technology and Metallurgy in Sofia in 2000. His professional career has been associated with research and teaching activities in the fields of physical chemistry, materials science and analytical chemistry. He has worked in research institutes in Germany – in Dortmund and Essen – where he participated in studies of aerosol microdroplets, spectroscopic analyses and the development of experimental apparatus. Since 2009 he has been working at the Institute of Physical Chemistry of the Bulgarian Academy of Sciences, where in 2017 he defended his doctoral dissertation and obtained the educational and scientific degree "Doctor". Since March 2022 he has held the academic position of "Chief Assistant". His scientific interests are focused on the synthesis and characterization of inorganic foam materials from waste raw materials, the thermal properties of materials and the application of spectroscopic methods. He has additional specializations in Germany and Italy, speaks English and German, and possesses computer skills in the field of scientific calculations and data processing.

2. Description of the submitted materials

Nikolay Bozhidarov Yordanov has submitted all required documents in accordance with the Law on the Development of the Academic Staff in the Republic of Bulgaria (ZRASRB), the Regulations for its application and the Internal Rules of the Institute of Physical Chemistry – BAS for the application of ZRASRB, both in paper and electronic form, namely: Application, European-format Curriculum Vitae; Diploma for the educational and scientific degree "Doctor" for a defended dissertation in professional field 4.2. "Chemical Sciences", scientific specialty "Physical Chemistry"; List and reprints of publications; Certificate of professional experience; Report on the fulfilment of the minimum national requirements according to ZRASRB.

According to the abstract, the doctoral dissertation of Dr. Yordanov is entitled "Analysis and characterization of conducting glass-forming systems by electrochemical methods" and was prepared in collaboration between IPC-BAS and the Otto Schott Institute, Jena, Germany. Twenty-four publications have been submitted in electronic form. Only one item is missing from the list: reprint of No. 8 – N. Jordanov, C. Schick, I. Gutzow, Nucleation and crystallization kinetics at variable supersaturation: A new isoconversional analysis approach, Proc. 4th Balkan Conference on Glass Science and Technology and 16th Conference on Glass and Ceramics, Vol. 1 Glass, Eds. B. Samuneva, S. Bachvarov, I. Gutzow, Y. Dimitriev, Publ. House Kamea Design Ltd. – Sofia, 2011. At the same time, a reprint of another conference paper by Dr. Yordanov is available: N. Jordanov, C. Mund and R. Zellner, "Investigations of the hygroscopic properties of ammonium sulfate and mixed ammonium sulfate and glutaric acid micro droplets by means of optical levitation and Raman spectroscopy". Both publications are from conferences and do not contribute points to the candidate's score. Of all publications in the

list, Nikolay Yordanov is the first author in 15 (62.5 %). The five articles presented as equivalent to a habilitation thesis were published after 2020, and in four of them Nikolay Yordanov is the first author.

In the submitted "Report on the fulfilment of the minimum national requirements", 19 of the presented articles are included, mainly excluding conference publications that carry fewer points and one of the chronologically oldest publications. In the section "articles equivalent to a habilitation thesis", the articles reflecting the most recent research topic of Nikolay Yordanov are indicated. Verification shows that the report on the fulfilment of the minimum national requirements has been calculated correctly according to the presented publications, citations and other materials. In total, Nikolay Yordanov scores 558 points against the required 420. The minimum national requirements, as well as the minimum requirements of IPC-BAS, are fully met.

3. General characteristics of the candidate's research and applied research activity

The publications (24 in number) in the submitted "List of publications that do not repeat those presented for the educational and scientific degree Doctor"[1] can be grouped into four chronologically ordered thematic groups:

1. 2003–2006 – Investigation of atmospheric aerosols and microdroplets – publications Nos. 1 and 2.
2. 2008–2010 – Electrochemical processes and kinetics of phase transitions – publications Nos. 3, 4, 5 and 6.
3. 2011–2019 – Structure, properties and synthesis of glassy, crystalline and glass-ceramic materials – publications Nos. 7, 8, 9, 10 and 11.
4. 2020–2026 – Synthesis and characterization of glass-ceramic materials and foam materials from industrial waste – publications Nos. 12–24.

All topics fall within the field of physical chemistry and clearly outline the scientific path of Eng. Dr. Nikolay Yordanov. His career began with studies of the hygroscopic properties and phase transitions of single aerosol microdroplets and mixed microparticles. It then continued with electrochemical processes and the kinetics of phase transitions, which naturally evolved into the synthesis and characterization of glassy, crystalline and glass-ceramic materials, including foam materials obtained from industrial waste. In his most recent research the main accents are:

- Preparation of glass-ceramic materials and foam materials from metallurgical slags and other industrial wastes;
- Investigation of the kinetics of sintering, crystallization and foaming;
- Influence of technological conditions, gas atmosphere and oxidation processes on the structure and properties of the materials;
- Valorization of industrial wastes and development of geopolymer and alkali-activated materials for construction applications.

The research methods used in the works of Eng. Dr. Nikolay Yordanov can be divided into two groups – synthesis methods and characterization methods. The synthesis methods include: selection and chemical characterization of iron-rich metallurgical slags, industrial sand and other waste raw materials; mechanical crushing and milling of the raw materials and of the obtained glass; sieving and particle-size separation of the powders; preparation of glass by melting of batches at high temperature

[1] The numbering of the papers in this Review follows this list.

followed by rapid quenching in water; forming of the powders by pressing to obtain samples of defined geometry; subsequent thermal treatment at different temperatures, heating rates, holding times and gas atmospheres. Among the characterization methods are: hot-stage microscopy (HSM), optical dilatometry (ODLT), differential thermal analysis (DTA), X-ray diffraction (XRD), scanning electron microscopy (SEM and SEM-EDX), X-ray micro-computed tomography (μCT) and others. Although the author has not performed the measurements by all these techniques himself, the wide range of methods demonstrates familiarity with their capabilities and the ability to combine them appropriately in a scientific investigation.

4. Main scientific and applied scientific contributions

The articles presented as equivalent to a habilitation thesis (Nos. 12–14, 17 and 19) form a coherent series on the utilization of metallurgical slag (up to 70 wt.%) through melting → frit → pressing of glass powders → controlled sintering/crystallization/foaming. The main contribution is the demonstration that three different products can be obtained from the same pressed powder green body by varying the thermal regime (and atmosphere/additives): dense sintered glass-ceramics (~950 °C), self-glazed materials (950–1000 °C) and glass-ceramic foams with high closed porosity (80–90 vol.%, 1100–1150 °C). This provides a flexible approach with clear industrial potential and constitutes a major contribution of the works of Eng. Dr. Nikolay Yordanov.

A solid experimental study is the investigation of the influence of CaF_2 (2.5–7.5 wt.%) on the melting, sintering, crystallization and foaming of glass-ceramics (No. 12). A decrease in temperatures and an increase in crystallinity with higher CaF_2 content have been shown, as well as the possibility of obtaining self-glazed materials or foams with ~80 % closed porosity.

The applied scientific contribution is high, as a direct demonstration of the use of slag + industrial sand for products with potential application in construction/insulation has been obtained. The reduction of production temperatures by means of fluoride is of practical relevance.

High scientific contribution is provided by the experiments clarifying the kinetics and mechanism of sintering and foaming of glass-ceramics from the same materials (metallurgical slag and industrial sand) in air and argon atmospheres (Nos. 13, 14, 17). It has been shown that in an inert atmosphere sintering is facilitated (lower temperature and activation energy), while foaming is suppressed; in air the foaming is intensive and can reach ~90 % closed porosity. An explanation involving a preliminary oxidation stage at lower temperature and subsequent reduction at higher temperature, which leads to foaming even in an inert atmosphere, has been proposed. A high Fe^{3+}/Fe^{2+} ratio favors the early onset of foaming. The process has been optimized for maximum foaming – article No. 21.

In the most recent works of Nikolay Yordanov an expansion of the research towards geopolymer and alkali-activated systems is observed. Publications Nos. 20, 22 and 24 (2025–2026) outline a new direction in his research activity:

- Characterization of cement kiln dust from Bulgarian cement plants;
- Alkali activation of steelmaking slag using cement kiln dust;
- Preparation of phosphate-activated geopolymer foam based on fayalite.

This demonstrates an expansion of the research scope from traditional glass-ceramic systems towards alternative binder systems and geopolymer materials.

As a summary of the research activity in recent years it can be stated that Nikolay Yordanov develops investigations in the field of synthesis and physicochemical characterization of glass-ceramic materials, foam materials and alternative binder systems obtained through the valorization of industrial wastes.

His scientific contributions are related to the study of the processes of sintering, crystallization and foaming, the establishment of the influence of technological parameters and gas atmosphere on the formation of structure and properties of the obtained materials, as well as the expansion of the investigated material systems through the use of various metallurgical and industrial secondary raw materials.

The applied scientific contributions consist in the development and investigation of approaches for converting industrial wastes into glass-ceramic materials, porous structures and geopolymer systems. These studies have potential for application in the field of construction materials and technologies for sustainable utilization of secondary raw materials, contributing to the development of materials science in the context of resource efficiency and the circular economy.

5. Impact of the candidate's scientific publications in the Bulgarian and international literature

The attached graph from the Scopus database shows a clearly expressed upward trend both in the number of scientific publications of Eng. Dr. Nikolay Yordanov and in the number of citations of his works (excluding self-citations). This positive dynamics is an indicator of the growing visibility of his scientific research and of its good reception by the international scientific community.

It is noteworthy that the list attached to the documentation presents 83 citations, while according to the data in Scopus the total number of citations by other authors, excluding self-citations, currently reaches 144. This substantial excess over the citations presented in the list is additional evidence of the dissemination and usability of the candidate's scientific results in contemporary research.

Particularly good reception by the scientific community has been given to some of the publications in the field of valorization of industrial wastes for the preparation of new material systems. For example, publication No. 12 from 2020 has been cited 32 times, publication No. 14 from 2021 – 10 times, publication No. 20 from 2025 – 9 times, and publication No. 21 from 2025 – 3 times. These data show that the research of Eng. Dr. Nikolay Yordanov is directed towards topical and promising scientific and applied scientific problems that attract interest and find resonance in the international scientific literature.

In particular, a significant place in his research activity is occupied by the development and characterization of materials based on inorganic industrial wastes, with emphasis on the preparation of glass-ceramic materials and foam materials with potential application in construction. This topic is especially relevant in the context of sustainable use of natural resources, reduction of industrial waste and development of technologies for their effective valorization.

6. Critical remarks and recommendations regarding the candidate's scientific works

It would be desirable in future scientific publications to pay even greater attention to the precise description of the experimental conditions and the apparatus used. For example, in publication No. 12 one model of tomographic apparatus is indicated, while the described measurement parameters – current and voltage of the X-ray tube – rather correspond to another model. In publication No. 17, when describing the tomographic investigations, apparatus of the Nikon company is indicated, while on the images presented in Fig. 8 remnants of the Bruker logo can be noticed.

These are probably technical inaccuracies in the preparation of the publications which, by themselves, do not give grounds to question the reliability of the obtained results. Nevertheless, such discrepancies

indicate the need for a more rigorous check of the experimental data and the accompanying information before publication.

7. Personal impressions of the reviewer about the candidate

Chief Assistant Dr. Nikolay Yordanov is a quiet, calm and non-confrontational colleague. He performs the assigned tasks carefully and responsibly. When participating in scientific forums he prepares thoroughly and presents himself convincingly. In recent years he has been the leader on the part of IPC of several scientific projects, which has enabled him to become familiar with the necessary documentation and administrative procedures. More active interaction with a wider circle of colleagues could be desired.

CONCLUSION

The research activity of Eng. Dr. Nikolay Yordanov has made a substantial contribution to the development of procedures for the valorization of inorganic industrial wastes as raw materials for the production of glass-ceramic materials with potential application in construction. Particular emphasis has been placed on the preparation of glass-ceramic foam materials, and a mechanism responsible for the foaming process has been proposed. The scientific contribution is qualitative and consistent, although not revolutionary. For a habilitation work in the field of physical chemistry it appears fully adequate and well balanced between applied orientation and fundamental aspects.

The scientific output of Eng. Dr. Nikolay Yordanov exceeds the minimum national requirements for holding the academic position of "Associate Professor" in the field of "Natural Sciences, Mathematics and Informatics", professional field 4.2. Chemical Sciences, scientific specialty "Physical Chemistry". On this basis I strongly recommend to the Scientific Jury that Eng. Dr. Nikolay Yordanov be awarded the academic position of "Associate Professor".

Date: 05.06.2026

Reviewer:

/Prof. Dr. Dragomir Tatchev/