Институт по ФИЗИКОХИМИЯ при БАН
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OPINION

regarding a competition for the academic position of "Associate Professor" in Professional Field 4.2. Chemical Sciences, specialty "Physical Chemistry," for the needs of the "Phase Formation, Crystalline and Amorphous Materials" Section announced in the State Gazette, Issue 63 of July 10, 2026

Candidate: Nikolay Bozhidarov Yordanov, PhD, Assistant Professor

Member of the Scientific Jury: Rashko Stefanov Rashkov, PhD, Associate Professor

1. General characteristics of the candidate's research and applied research activities.

The works of Assis. Prof. Dr. Nikolay Yordanov conducts research across a broad range of physical chemistry. This includes studies on progressive and instantaneous nucleation during the electrochemical growth of single copper crystals, as well as nucleation in supercooled supersaturated aqueous solutions. His research further addresses melting kinetics under varying external parameters—such as supersaturation and temperature—along with the kinetics of chemical reactions, phase transitions, structural relaxation, and crystallization (vitrification) within the framework of non-isothermal kinetics. The theoretical results obtained are illustrated with examples concerning nucleation and growth kinetics during the crystallization of polymer melts, processes in supersaturated aqueous solutions, the crystallization of glasses, the glass transition, and the electrolytic deposition of metals under galvanostatic conditions. Particular attention is devoted to the synthesis of well-sintered glass-ceramics and glass-ceramic foams, as influenced by temperature and the atmosphere employed. Finally, it is worth noting his research into the potential for producing glass-ceramic materials through the utilization of industrial and municipal waste.

To a large extent, the aforementioned research aligns with the subject matter of 11 projects in which Assistant Professor Dr. Nikolay Yordanov has participated.

For the competition for the academic position of "Associate Professor," the candidate has submitted a total of 19 scientific works, distributed as follows:

Indicators Group B: scientific publications indexed in internationally recognized databases—equivalent to a habilitation thesis—comprising 2 Q1 articles, 2 Q2 articles, and one with an SJR ranking, totaling 100 points (meeting the required minimum of 100), with the candidate listed as the first author on 4 of these.

Indicators Group G – 11 scientific publications in journals refereed and indexed in internationally recognized scientific databases (Web of Science and Scopus), excluding the habilitation thesis, plus 3 book chapters – totaling 242 points (against a required minimum of 220).

Indicators Group D – citations in scientific publications indexed in internationally recognized scientific databases (Web of Science and Scopus) – totaling 166 points (against a required minimum of 60), derived from just 8 works, two of which have a significant number of citations 26 and 36, respectively.

The candidate's scientific works align with the subject matter of the competition and do not duplicate those included in the procedure for the acquisition of the educational and scientific degree of "Doctor" (PhD).

The data presented demonstrate that the candidate for the academic position of "Associate Professor" not only meets but exceeds the minimum national requirements, as well as the additional requirements stipulated in the Regulations for the Implementation of the Act on the Development of the Academic Staff in the Republic of Bulgaria (ADASRB) and the specific

internal regulations of the Institute of Physical Chemistry at the Bulgarian Academy of Sciences (IPC-BAS).

2. Main scientific and applied scientific contributions.

As previously mentioned, the scientific work of Assis. Prof. Dr. Nikolay Yordanov encompasses many aspects of physical chemistry, with a primary focus on the synthesis and sintering of glass-ceramics and glass-ceramic foams.

To elucidate the influence of the high-temperature synthesis atmosphere on the autocatalytic foaming process in thermally sintered glass-crystalline forms, a unique closed chamber designed for operation in an argon atmosphere was constructed. This chamber incorporates a thermo-optical system (TOS) from a non-contact optical dilatometer, integrated with a high-temperature heating microscope. The innovative aspect of this research lies in the application of a sinter-crystallization method for the synthesis and production of sintered glass-ceramics and/or glass-ceramic foams, as well as the use of a controlled atmosphere during the synthesis process—given that both air and argon environments directly affect sintering kinetics. It has been demonstrated that synthesis in an inert atmosphere result in materials with a higher degree of sintering, whereas the foaming process is favored in an air atmosphere. Foam materials with improved properties and distinct structural characteristics were successfully produced by employing a two-stage heat treatment: a first stage involving low-temperature sintering at 950 °C, followed by a second stage involving foaming at 1100 °C.

A significant contribution lies in the production of three distinct types of materials—sintered glass-ceramics, self-glazed materials, and glass-ceramic foams—obtained through a sequential series of thermal treatments by varying the firing regime. Specifically, a heating rate of 10 °C/min combined with thermal treatment at 950 °C yields a well-sintered glass-ceramic with a bulk porosity of approximately 10% and a moderate degree of crystallization (around 35%). Increasing the heating rate to 20 °C/min, followed by a brief hold at 1020 °C, results in a product with a slightly deformed surface that exhibits self-glazing, characterized by a relatively smooth finish. Further increasing the heating rate to approximately 30 °C/min, with a hold at 1100 °C, leads to the formation of novel fire-resistant sintered glass-ceramic foams featuring a cellular structure and a closed porosity of approximately 85–95 vol.%. These variations in the sintering temperature allow the control of open porosity, thereby enabling the design of materials suitable for applications in filtration or catalysis. The results are supported and explained through the kinetics of the sintering process, based on sintering curves recorded at heating rates of 2, 10, and 30 °C/min in both air and argon atmospheres, as well as the application of an Arrhenius-type analysis method. It has been demonstrated that the oxidation of Fe^{2+} and Mn^{2+} ions cannot occur when processing takes place in an inert atmosphere. Although activation energies are lower in an argon environment, sintering in an inert atmosphere proceeds at lower temperatures. These characteristics are attributed to a higher content of Fe^{2+} ions—which act as network modifiers—in experiments conducted under an argon atmosphere. Thus, by adjusting the temperature—and consequently altering viscosity and redox processes (ferrous/ferric)—it becomes possible to produce various sintered glass-ceramic materials. A detailed investigation into the redox processes within the synthesized materials, along with an analysis of how the oxidation state of transition metal oxides influences the structure and properties of the final products, constitutes a significant contribution of the candidate's work. It has been established that the presence of Fe^{2+} (ferrous) ions, acting as modifiers within the glassy structural network, leads to a reduction in viscosity; conversely, their complete oxidation to Fe^{3+} (ferric) ions—which function as transition metal

oxides within the glass structure—results in an increase in viscosity. Preliminary heat treatment effectively ensures complete oxidation, which is a prerequisite for improved foaming.

Last but not least, I would highlight the effect of adding CaF_2 to the batch on the melting, sintering, crystallization, and foaming of the glass powder, which leads to a reduction in production costs. This corresponds to a significant decrease in both the melting and sintering temperatures. It has been shown that variations in the CaF_2 content, particle size fraction, heating rate, and holding temperatures alter the sintering behavior, phase formation, and foaming capacity.

Undoubtedly, these results—largely the work of the candidate—would enrich existing knowledge and theories regarding the synthesis and sintering of glass-ceramics and glass-ceramic foams. From an applied perspective, the inorganic materials obtained via thermal foaming can be utilized as advanced construction materials and insulation products across various fields and industries. The candidate's capacity for the detailed investigation of phenomena and processes in this domain will contribute to the advancement of the subject matter, as well as to the transfer of his experience to younger colleagues.

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

According to the scientific works of the Assistant Professor Dr. Nikolay Yordanov, a total of 144 citations (without self-citations) from 16 documents (referenced in Scopus) were noticed. One of the articles referring to the effect of CaF_2 was cited 34 times, which is a testimony to the topicality of the topic and the impact of the results.

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

I have no critical remarks for the candidate; I offer only one recommendation: to exercise greater care in the technical preparation of the documentation.

CONCLUSION

Assistant Professor Dr. Nikolay Yordanov not only meets but exceeds the minimum national requirements, as well as the additional criteria stipulated in the Regulations for the Application of the Act for the Development of the Academic Staff in the Republic of Bulgaria (ADASRB) and the internal regulations of the Institute of Physical Chemistry at the Bulgarian Academy of Sciences (IPC-BAS), for the academic position of "Associate Professor." The scientific works of the candidate, Assis. Prof. Dr. Nikolay Yordanov, encompass both fundamental and applied research, contributing to the advancement of the science and technology regarding the synthesis and sintering of glass-ceramics and glass-ceramic foams. Assis. Prof. Dr. Nikolay Yordanov is an accomplished researcher with scientific interests in the devitrification of glasses, the glass transition, and the production of glass-ceramic materials utilizing industrial and local waste. Given his extensive theoretical background and his experience working within teams on significant projects, he possesses the capability to supervise junior researchers. I consider that he fully meets the requirements for the academic position of "Associate Professor" in Professional Field 4.2 Chemical Sciences, specialty "Physical Chemistry," and my assessment is positive.

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Prepared by: (
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