

REPORT

on the competition for the academic position Associated Professor

in the professional field 4.4. Earth Sciences (Applied mineralogy, innovative building materials) for the needs of Department „Experimental Mineralogy and Crystallography” at the Institute of Mineralogy and Crystallography - Bulgarian Academy of Sciences (IMC-BAS)

announced in the State Newspaper, issue 56 on 19.07.2022.

Candidate: Assistant Professor, PhD Alexander Nikolaev Nikolov, IMC-BAS

Member of the Scientific Jury: Corr. member, Prof., DSC Stanislav Vassilev Vassilev, IMC-BAS

1. General characteristics of the presented materials

The results of the scientific activity of the candidate in the period 2017–2022 г. are presented in 24 publications after acquisition of PhD degree, and they are listed in Appendices №7 and №10. Dr Nikolov presents 22 scientific publications for participation in this competition (Appendix №17: Report on the implementation of the minimum requirements for occupying the academic position Associated Professor), distributed as follows: 10 publications comprise his habilitation work (group B indicators), and 12 publications are outside the habilitation work (group G indicators). Sixteen of these articles are published in journals referred in the world-famous databases of scientific information Web of Science (WoS) and Scopus as 3 of them have impact factor (JIF in WoS) and 7 have impact rang (SJR in Scopus). Most of the journals (14) are categorized in quartiles by WoS and Scopus, as follows: 1 in Q1, 4 in Q2, 1 in Q3, and 8 in Q4. The candidate is a sole author of 10, first author of 8, and third and subsequent author of 4 of these publications.

The information about citations of Dr Nikolov (Appendix №9), extracted from the SONIX system of BAS for the review period 2017-2021 г., enlists 135 citations and according to this information the h-index of the applicant is 4 (group D indicators in Appendix №17). According to the Scopus database, candidate’s publications have been cited 130 times, and his h-index is 3.

Dr Nikolov has presented his scientific results at 20 scientific events (5 of them abroad) by 8 oral reports and 17 poster presentations (Appendix №11). The candidate has participated in 6 research projects funded outside of the budget subsidy of BAS (FNI, others) in the period 2017-2021, and he has been project coordinator for 3 of these projects (Appendix №12).

The materials submitted for this contest ensure the following points for the candidate under all groups of indicators: Indicators “A” – 50 points (50 required); Indicators „B“ – 227 points (100 required); Indicators „G“ – 271 points (220 required); Indicators „D“ – 657 points (60 required).

The evaluation of the materials submitted shows that the quantitative scientific indicators of Dr Nikolov cover and significantly exceed the minimum national requirements, as well as the enhanced criteria of BAS and IMC for occupying the academic position Associated Professor in the professional field 4.4. Earth Sciences.

2. General characteristics of the scientific, scientific-applied and pedagogical activity of the candidate

The scientific activity of Dr Nikolov is basically related to preparation of geopolymer materials based on natural raw materials and/or waste products from energy and metallurgy, as well as to characterization of the properties of the prepared new materials for their potential

use in the construction industry. The influence of composition and type of the precursors used, concentrations and type of different activators and additives, as well as the synthesis conditions on the mechanical and physicochemical properties of the prepared geopolymers were studied.

The above research topic has a clear applied purpose and it is especially important at present in order to find new innovative substitutes of the conventional high-energy consuming Portland cement and other building materials with high carbon footprint. The investigations of Dr Nikolov on the synthesis of geopolymers based on natural zeolites, which took place in his PhD thesis and are still ongoing currently, are worth in case the prepared new materials have unique properties. The candidate is rightly directed his efforts to the use of industrial by-products available in big amounts (fayalite slag from copper industry, fly ash from coal-fired power stations) as precursors for geopolymer materials. This would have an important contribution for decreasing quantities of the deposited wastes and their negative influence on the environment.

No information about pedagogical activity of the candidate is given in the submitted documents.

3. Main scientific and/or scientific-applied contributions of the candidate.

The scientific achievements in the most of candidate's publications are related to optimization of the geopolymers' preparation process by testing different types of raw materials and different types and concentrations of activating solutions and additives, as well as characterization of the structure and properties of the produced materials by a complex of methods. The personal contribution of Dr Nikolov to these studies is sharply outlined in the presented 18 publications on the topic where he is a sole (10 publications) or first (8 publications) author. The contributions have both basic and applied character, and according to the type of raw materials used can be grouped as follows:

1. Geopolymer materials based on zeolite (natural clinoptilolite from Beli plast deposit or calcined zeolite at 900°C) are produced using different concentrations of sodium, potassium or aluminate activators. The structure of the produces materials is studied and the impact of the activating solution on their mechanical indicators is discussed. High adhesive strength to concrete is established for geopolymer paste produced using calcined zeolite as a precursor and industrial waste aluminate solutions as activator [publications 1,2,3,6,7,8,14].

2. Geopolymer materials based on fly ash from Maritsa East 2 thermoelectric power plant are prepared. A lightweight porous geopolymers were developed with addition of peroxide (H_2O_2) as gas forming agent. The impact of elevated temperature (from 400 to 1150 °C) on their structure is studied and their potential application as fire-resistant material is proven [publications 4, 10, 12].

3. New geopolymer materials based on fayalite slag from copper producing plant (Aurubis, Pirdop) were prepared. High strength geopolymers (113,9 MPa on 90th day) were synthesized by optimization of the concentrations of alkali activators and addition of metakaolin [publications 15,16, 20]. It is announced that a technology for preparation of a paving-block consisted of wasted plastic covered by protective geoplolymer paste based on fayalite slag is to be patented.

4. For the first time, a fast-hardening one-part geopolymer cement (previously milled and homogenized dry mixture used for preparation of fresh geopolymer pastes by "just-add water" method) is developed using fayalite slag and $Ca_5(P_3O_{10})_2$ (calcium tripolyphosphate or super phosphate) as a hardening activator. The influence of the activator concentrations on the setting time and properties of the geopolymers obtained is studied [publications 5, 15, 17].

Four co-authored publications on various topics in the field of mineralogy are also presented [publications 11,13,19,22]. They are related to participation of the candidate to

different projects, and include: characterization of turquoise from Chala deposit; flint artefacts from archaeological sites; ion exchange of Cs^+ and Sr^{2+} by natural clinoptilolite Beli plast deposit; and modes of W occurrence in the oxidation zone of the Grantcharitsa deposit. The candidate's contribution to these publications is difficult to estimate (third and subsequent author); however, his curiosity to different aspects of mineralogy and crystallography makes a good impression.

Finally, I consider that the scientific achievements of Dr Nikolov can be assessed as enrichment of existing knowledge in the topic studied through process optimization and finding new facts and relations during synthesis and characterization of the properties of the new materials produced.

4. Critical remarks and recommendations

The candidate has wrongly cited professional field 5.7. Architecture, construction and geodesy in Appendix №17 "Report on the implementation of the minimum requirements for occupying the academic position Associated Professor". Nevertheless, I accept this report as a correct one because the cited criteria are fully identical with the criteria in the professional field 4.4. Earth Sciences. There are also some insignificant technical mistakes in the documents presented. I recommend Dr Nikolov to extend his future investigations on: (1) synthesis of geopolymers as new construction materials based on additional high volume waste products from metallurgy, energy production, chemical industry, agriculture and forestry; as well as (2) synthesis of geopolymers for inertization (immobilization) of toxic and potentially toxic components during deposition of hazardous wastes.

CONCLUSION

The analysis of documents submitted by Assistant Professor Dr Alexander Nikolov shows that he fully complies with the requirements of the Law for the development of the academic staff in Republic of Bulgaria, the Rules for its implementation, as well as with the respective regulations of IMC-BAS for occupying the academic position Associated Professor. The research topic of Dr Nikolov is in line with the announced topic of the competition "Applied mineralogy, innovative building materials".

Based on the above considerations, I give my positive assessment of the candidate's scientific achievements. I convincingly recommend to the honorable Scientific Jury and Scientific Council of IMC-BAS Assistant Professor Dr Alexander Nikolaev Nikolov to be elected on the academic position "Associated Professor" in the professional field 4.4. Earth Sciences for the needs of Department „Experimental Mineralogy and Crystallography“ at IMC-BAS.

02.11.2022

Reviewer:

/ Corr. member, Prof., DSc Stanislav Vassilev /