REVIEW

Regarding a competition for the academic position of "Associate Professor" in Natural Sciences, Mathematics, and Informatics, Professional Field 4.4 Earth Sciences (Mineralogy and Crystallography), for the needs of the "Experimental Mineralogy and Crystallography" at the Institute of Mineralogy and Crystallography "Acad. Ivan Kostov" (IMC-BAS).

Announced in the “State Gazette”, Issue 56, June 19, 2026.

Prepared by:

Member of the Scientific Jury: Prof. Stefka Pristavova PhD, Department of Hydrogeology and Engineering Geology, Faculty of Geological Prospecting, "St. Ivan Rilski" University of Mining and Geology.

Candidate: Main Assistant Professor Liliya Vladimirova Tsvetanova PhD, Institute of Mineralogy and Crystallography "Acad. Ivan Kostov".

General characteristics of the submitted materials

This review was assigned to me on September 11, 2026, during a meeting of the Scientific Jury appointed by Order No. 446RD-09, dated August 7, 2026, issued by the Director of the "Acad. Ivan Kostov" Institute of Mineralogy and Crystallography. It has been prepared in accordance with the requirements of the “Law on the Development of the Academic Staff in the Republic of Bulgaria” and the Regulations for its Implementation, as well as the Regulations on the Conditions and Procedures for Acquiring Scientific Degrees and Occupying Academic Positions at the Institute of Mineralogy and Crystallography – BAS (IMC-BAS). The candidate for the competition announced by the Institute of Mineralogy and Crystallography "Acad. Ivan Kostov" for the academic position of "Associate Professor" (Docent) in the scientific field 4.4 Earth Sciences (Mineralogy and Crystallography)-specifically for the "Experimental Mineralogy and Crystallography" division is Chief Assistant Professor Liliya Vladimirova Tsvetanova. PhD.

Main Assistant Professor Liliya Tsvetanova, PhD obtained her Master’s degree in Geochemistry from the "St. Ivan Rilski" University of Mining and Geology in 2002. Between 2011 and 2017, she was a PhD student at the IMC-BAS, where she successfully defended her PhD thesis. She has served as an Assistant at the IMC-BAS since 2015, and as a Main Assistant Professor since 2019. Her submitted curriculum vitae highlights the following key activities: the synthesis, modification, and characterisation of functional inorganic materials; investigation of exchange processes and the kinetics of heavy metal adsorption onto suitable adsorbents, in the context of environmental protection and/or water purification; contribution to research and publications in the fields of X-ray fluorescence analysis and heavy metal adsorption; processing and interpretation of experimental data related to X-ray fluorescence analysis and adsorption studies; participation in projects funded by national and international scientific programs.

For participation in the present competition, Chief Assistant Professor Liliya Tsvetanova, PhD has submitted a list of 21 publications, none of which were included in the materials presented for the acquisition of her PhD degree. The candidate has also provided all

other required materials and documents, in compliance with the "Law on the Development of the Academic Staff in the Republic of Bulgaria" and its Regulations for Application, as well as the Regulations on the Conditions and Procedure for Acquiring Scientific Degrees and Occupying Academic Positions at the IMC-BAS.

This review is based on the 21 submitted publications subject to evaluation. According to the provided statement regarding compliance with the minimum national requirements under Article 2b of the "Law on the Development of the Academic Staff in the Republic of Bulgaria", indicator B4—covering scientific publications in journals indexed and abstracted in Web of Science and Scopus (all in the first quartile, Q1)—accounts for a total of 100 points. Indicator G (total 261 points) includes 17 scientific publications—excluding the habilitation thesis—published in scientific outlets indexed and abstracted in Web of Science and/or Scopus.

The citations of the candidate's work (listed in Appendix 8 and presented under indicator D) exceed the required minimum (136 points). Only citations from publications indexed in Web of Science and Scopus have been included. The author's summary states that the total number of citations of the publications (excluding self-citations) is 53, with 25 of these being used for the competition.

Appendix 10 lists 18 instances of participation in international scientific conferences.

Table. Scientometric indicators for appointment to the academic position of "Associate Professor"

Indicators	Minimum requirement	Achieved by the candidate
Group A	*50 points*	*50 points*
Group B	*100 points*	*100 points*
Group Г	*220 points*	*261 points*
Group Д	*60 points*	*136 points*
Total:	*430 points*	*547 points*

Brief Overview of the Candidate's Scientific Activity

The candidate's contributions span experimental mineralogy, crystallography, and materials science. They encompass synthetic titanosilicates, natural and modified zeolites, geopolymer and ceramic materials, composite catalysts, technogenic products, and natural raw materials. The methods employed include XRF, XRD, electron microscopy, and IR spectroscopy. The results deepen the understanding of ion exchange (ion-exchange processes), sorption, phase formation, and structural-phase transformations. These findings apply to water and gas purification, detoxification, waste valorisation, and the development of eco-friendly materials. Based on the thematic focus of the publications and the original scientific contributions, the research activity is organised into the following main areas:

- Synthesis, modification, characterisation, and application of natural and synthetic mineral materials;
- Investigation of the sorption, catalytic, and biological properties of natural and synthetic materials;
- Characterisation and utilisation of natural and technogenic raw materials for the production of geopolymer, ceramic, and cementitious materials;
- Mineralogical, crystal-chemical, and analytical studies.

Synthesis, modification, characterisation, and application of mineral materials. The primary focus of this research is establishing the relationship between the chemical composition, structural features, and functional behaviour of the developed materials. The results obtained expand the possibilities for the targeted modification of mineral and synthetic materials, enabling their application in new, environmentally oriented fields—such as the purification of contaminated water, the development of geopolymer coatings for long-lasting antimicrobial use, and the application of a modified natural product (clinoptilolite) as a functional mineral material for biomedical purposes.

Sorption, catalytic, and biological properties. Research in this area focuses on establishing the principles that govern the functional behaviour of natural and synthetic materials as they interact with various pollutants and biological systems. The findings enhance our understanding of the factors determining their efficiency and demonstrate their potential for application in environmental and biomedical fields. Key developments include: 1) the creation of Mn-, Cu-, and Ag-modified NaX zeolites—produced via ion-exchange procedures and impregnation with silver nanoparticles—which exhibit significantly higher efficiency in the catalytic decomposition of ozone; 2) the evaluation of clinoptilolite tuffs from four Bulgarian deposits (Beli Plast, Golobradovo, Most, and Beliya Bair) for use as sorbents for detoxification purposes; 3) the development of Cu-modified forms of natural clinoptilolite, expanding its potential use as a low-cost photocatalyst for wastewater treatment; 4) the confirmation of the biological safety and suitability of modified natural clinoptilolite as a functional mineral additive for animals; and 5) the development of novel composite catalysts based on natural manganese carbonate ore, thereby broadening the scope for utilizing mineral materials in the catalytic purification of gaseous and aqueous pollutants.

Utilisation of natural and technogenic raw materials. The studies in this area focus on the physicochemical characterization and targeted utilization of natural and technogenic raw materials for the development of geopolymer, ceramic, cementitious, and other functional materials. A primary emphasis is placed on establishing the relationships between the chemical and mineralogical composition of the starting materials, processing conditions, and the resulting structural-phase transformations—factors that determine the properties and suitability of these materials for the development of products and technologies with a high environmental benefit. Key findings include: 1) the identification of the principles governing the formation of geopolymer and ceramic materials from natural and technogenic raw materials, including the demonstration that powdered waste from electrical and electronic equipment can serve as a precursor for geopolymerization; 2) the development of pyroxene-based ceramic materials via solid-state sintering of natural loess from the Danube Plain; and 3) the characterization of cement kiln dust (CKD) from three Bulgarian cement plants, highlighting the necessity of evaluating such material based on its specific composition and origin when determining the most appropriate application for its utilization as a secondary raw material. 4) The influence of high-energy mechanical activation on the crystal-chemical transformations within the mineral apatite and associated mineral phases in natural phosphorites from the Toolse and Kabala deposits (Estonia) has been elucidated; the results obtained demonstrate the feasibility of acid-free mechanochemical activation of natural phosphorites for their direct application as soil amendments and natural mineral fertilisers.

Mineralogical, crystal-chemical, and analytical studies. The research in this area focuses on the application of modern mineralogical, crystal-chemical, and analytical methods to elucidate the mineral and chemical composition, crystal structure, phase transformations, and formation conditions of natural mineral associations, as well as to evaluate their potential applications. Specifically: 1) the distribution patterns of minor and trace elements in pyrite and marcasite from the Sarnak low-sulfide gold deposit have been determined; 2) secondary sulfate minerals in the Lozen ore field have been characterized—with the identification of epsomite, pickeringite, and alunogen—and a mechanism and sequence for the formation of this secondary sulfate mineralization under cyclic humidity variations have been proposed; 3) a detailed crystal-chemical investigation of serpierite from Zvezdel (Bulgaria) and the type locality of Lavrion (Greece) has been conducted; and 4) Bulgarian natural raw materials—including marls and Mg-rich non-marly materials—have been investigated as potential source materials for the production of high-quality ceramics of the "yellow paving brick" type.

All scientific publications submitted by the candidate Liliya Tsvetanova for this competition are co-authored. Given the complexity of the research, the reviewer does not consider this a drawback—especially since the candidate has specified her personal contribution to these studies in the submitted documentation. The reviewer acknowledges these contributions, which include: the synthesis, modification, and ion-exchange treatment of a significant portion of the materials; their characterization via WDXRF and XRD; the interpretation of their chemical and phase composition; and the generalization of the relationships between the structure, composition, and properties of the materials under study.

Conclusion

The candidate, Liliya Tsvetanova, PhD (holding the academic rank of Chief Assistant Professor), is a researcher in the fields of experimental mineralogy, crystallography, and materials science. The results obtained from her research possess specific applied value: they contribute to a deeper understanding of the mechanisms underlying ion exchange, sorption, phase formation, and structural-phase transformations. Furthermore, they expand the potential applications of the studied materials in areas such as the purification of water and gas streams, detoxification, the valorization of industrial and plant-based waste products, and the development of materials with environmental and technological utility.

This review, based on the documents and materials submitted for the competition, indicates that the candidate meets the requirements outlined in the “Act on the Development of the Academic Staff in the Republic of Bulgaria” and its Regulations for Application, as well as the “Regulations on the Conditions and Procedure for Occupying the Academic Position of "Associate Professor" at the Institute of Mineralogy and Crystallography, BAS”. The candidate’s scientific studies and contributions to the field of experimental and applied mineralogy provide me with grounds to recommend that the members of the Scientific Jury propose to the Scientific Council of the Institute of Mineralogy and Crystallography, BAS, that Main Assistant Professor Lilia Tsvetanova be appointed to the academic position of "Associate Professor" in Professional Field 4.4: Earth Sciences (Mineralogy and Crystallography) in the direction "Experimental Mineralogy and Crystallography".

03.11.2026 г. The reviewer: Заличено съгласно чл. 2 от ЗЗЛД

/prof. Stefka Pristavova, PhD/