OPINION

on the competition for the occupation of academic position "Professor" in the professional field 4.2. Chemical Sciences (Processes and Apparatuses in Chemical and Biochemical Technology) for the needs of the "Transfer Processes in Multiphase Media" laboratory, Institute of Chemical Engineering at the Bulgarian Academy of Sciences (ICE-BAS).
Announced in the State Gazette, No. 77 of 10.09.2024.
Candidate: Tatiana Stefanova Petrova, PhD, Associate Professor
Prepared by: Margarita Dimitrova Popova, Doctor of Science, Professor

1. **Brief Biographical Data and Characterization of the Candidate's Scientific Interests.**
The candidate for the announced competition is Associate Professor Dr. Tatiana Petrova. She was born in 1966. She received her Master's degree from the Faculty of Mathematics and Mechanics, Sofia University "St. Kliment Ohridski" in 1989, and in 2008, she obtained the educational and scientific degree "Doctor" in the field 02.10.09 "Processes and Apparatuses in Chemical and Biochemical Technology" at the University of Chemical Technology and Metallurgy (UCTM) Sofia, with a dissertation on "Mathematical Modeling of Liquid and Gas Distribution in Packed Columns". She has held positions as a programmer and mathematician at the IMBM-BAS, a senior researcher at ICE-BAS, and since February 2011, she has been an Associate Professor at ICE-BAS.
Dr. Petrova's research interests focus on modeling fluid and gas flows in packed columns. The results obtained are of significant importance in overcoming issues of uneven phase distribution in packed columns, which reduces their efficiency and complicates process prediction and scaling.

2. **General Characteristics of the Candidate's Research and Applied Scientific Activities (including participation in national and European projects, expert activities, supervision of PhD students, scientific-organizational work, etc.).**
Dr. Petrova is the leader of the project: "Optimal Safe Loading and Geometry for Layered Nanocomposites under Thermo-Mechanical Load" from 2021, funded by the National Science Fund. She has participated in the implementation of 2 projects funded by the National Science Fund and 6 projects funded by Deutsche Forschungsgemeinschaft (DFG).
She has supervised one successfully defended PhD student and two Master's thesis students. Since 2018, she has been the chair of the Colloquium at ICE-BAS, and since 2024, she has also been the chair of the National Council of ICE-BAS.
Dr. Petrova has participated in academic committees for faculty appointments: 4 for Associate Professor and 1 for Professor, and for academic degrees: 2 for Doctor and 1 for Doctor of Sciences. She has been a reviewer for project proposals and reports of projects funded by the National Science Fund and BAS, and for many scientific journals. She has also been a member of the program and organizing committees of 7 international and national scientific forums.
This overview clearly demonstrates that Dr. Petrova is an established expert and a scientist with a strong project activity.

3. **Evaluation of the Submitted Materials (Number and Characteristics of Submitted Works - Scientific Publications, Monographs, Research Projects, Patents, Textbooks, etc.).**
Dr. Petrova is the author of 85 publications, which have been cited 165 times. Her h-index is 7, calculated based on the submitted citations.

She participates in the competition with 25 publications, including 9 publications under **criterion B** (139 points, with 100 points required) and 14 publications and 2 book chapters under **criterion G** (271 points, with 250 points required).
Under **criterion E**, Dr. Petrova earns 25 points for successfully supervising a PhD student, 20 points for participation in two projects funded by the National Science Fund, 6 points for participation in 6 projects funded by DFG, and 20 points for leading a scientific project funded by the National Science Fund, bringing a total of 185 points, exceeding the minimum required 150 points.
The total score across all criteria is 777 points, exceeding the minimum required 640 points according to the criteria for the academic position of professor as per the Methodology for Career Development of Scientists at ICE-BAS, and the Regulations for the Application of the Act on the Development of Academic Staff in Bulgaria (ZRASRB) at BAS.

4. **Main Scientific and Applied Contributions.**
The research of Dr. Petrova is mainly focused on modeling fluid and gas flows in packed columns. The results contribute significantly to solving the problem of uneven phase distribution in packed columns, which reduces their effectiveness and complicates the prediction and scaling of the processes within them.
The candidate's contributions in this field are presented in publications under **criterion B**, divided into studies of gas phase flows (publications 1, 2, 3, and 8) and liquid phase flows (publications 4, 5, 6, 7, 9).
For gas phase processes (publications 1, 2, 3, and 8), the research has contributed to quantitative assessments of phase unevenness. Experimental measures have been proposed to reduce unevenness in gas distribution devices, and a new graphical method has been introduced for determining the number and location of zones with uniform local velocities across the cross-section of the column. New empirical equations have been derived for determining the hydraulic resistance of dry and wetted structured packing, as well as the gas velocity at the hold-up point, considering the geometric characteristics of the packing. Numerical modeling has been proposed for the influence of hydrodynamics of gas flow on heat and mass transfer during the flow over a single catalyst particle.
The main results in the liquid phase (publications 4, 5, 6, 7, 9) are theoretical, where new methods for identifying model parameters of dispersion models have been proposed. Combining the model with unevenness assessments allows for a more accurate consideration of liquid distribution in the wall region. An improved design for sprinklers and collectors has been proposed, and missing experimental data have been obtained for three types of packing with open structures.
In **criterion G**, a total of 16 publications are presented, covering results from two main topics: "Modeling and Optimization of Composite and Nanocomposite Structures" (publications 10-15, 19, 20, 22 and 23) and "Designing Optimal Resource-Providing Chains in the Dairy Industry" (publications 16-18 and 21; book chapters 24, 25).
Contributions in the first topic are related to the modeling and optimization of composite and nanocomposite structures subjected to static and dynamic mechanical loads. The results have significant practical implications for industries involving parts like wind turbine blades, elbows, sensors, and construction insulation materials. The contributions to the second topic are related to addressing a range of environmental, economic, and social issues in the design of optimal resource supply chains for dairy product production from various raw materials, using different technologies, and involving different numbers of suppliers, factories, and markets. A deterministic

optimization approach has been proposed for designing the product portfolio of a sustainable resource supply chain.
The contributions in the scientific publications of Associate Professor Petrova are clearly defined with practical benefits. They reveal her as a well-established scientist with strong publication and project activity, a clear scientific focus, and a personal contribution to science. In the 25 publications presented in the competition, she is the corresponding author of 11 publications (44%), which demonstrates her substantial contribution.

5. **Impact of the Candidate's Scientific Publications in Bulgarian and International Literature.**
Dr. Tatiana Petrova's publications have been widely recognized, with 165 citations in national and international journals, of which 66 citations are for the publications submitted in this competition for the academic position of professor, which earns her 132 points under criterion D, exceeding the required 100 points according to the Methodology for the Career Growth of Scientists at ICE-BAS.

6. **Critical Remarks and Recommendations.**
I have no critical remarks on the materials submitted for the competition.

CONCLUSION
Based on the materials and scientific works presented in the competition, I believe that Associate Professor Dr. Tatiana Stefanova Petrova fully meets the requirements for the academic position of "Professor" according to the Law of the Development of the Academic Staff in the Republic of Bulgaria (ZRASRB), Regulation for the implementation of ZRASRB, the relevant Regulations for the Acquisition of Academic Degrees and the Appointment to Academic Positions at BAS and the specific conditions outlined in the Methodology for the Career Growth of Scientists at ICE-BAS. Her scientific output and competence, with a clear focus on mathematical modeling of flows in packed columns and assessing flow unevenness in packed columns and gas distribution devices, are of significant importance for the industry. Furthermore, her participation in leading and executing scientific projects, as well as training young specialists, gives me confidence to express a positive opinion and recommend to the members of the National Council of ICE-BAS to vote positively for Tatiana Petrova for the academic position of "Professor" in the professional field 4.2. Chemical Sciences (Processes and Apparatuses in Chemical and Biochemical Technology) in ICE-BAS.

January 6, 2025

Prepared by: [redacted]
/Prof. DSc. Margarita Popova/