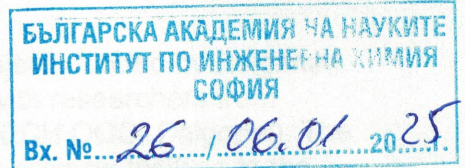


## REPORT

by Prof. Maxim Boyanov



regarding

the materials submitted for the competition for the academic position "professor" under professional direction 4.2. Chemical Sciences (Processes and Apparatus in Chemical and Biochemical Technology), for the needs of Laboratory "Transfer Processes in Multiphase Media" of the Institute of Chemical Engineering – Bulgarian Academy of Sciences (IChE-BAS). The position opening was published in State Gazette No. 77/ 10.09.2024.

The only candidate who submitted documents for the announced competition is Assoc. Prof. Tatyana Petrova.

Assoc. Prof. Petrova graduated in 1989 from the Faculty of Mathematics and Informatics (FMI), Sofia University "St. Kliment Ohridski" (SU), with a specialization in "Fluid Mechanics", after which she worked as a programmer and a mathematician at the Institute of Mechanics and Biomechanics (IBMB-BAS) until 1991, then as a graduate student at FMI-SU until April 1996, and then as a mathematician at the IBMB-BAS until September 1996. Since September 1996, she has been working at the Institute of Chemical Engineering (IChE) as a research associate of III, II, and I rank (respectively until 2005, 2008, and 2011). While working at IChE, she also completed her doctoral studies (2006-2009), defending her dissertation "Mathematical modeling of the distribution of liquid and gas in packed columns" on September 29, 2008. In 2011 she successfully passed a competition for an associate professor position, and from 2011 until now she has been working as an associate professor at IChE-BAS.

The candidate for professor Tatyana Petrova submitted to the competition a total of 25 publications (23 articles in scientific journals and two chapters in a book), all published between 2014 and 2022.

The articles are distributed as follows:

**In journals with impact factor – 23:** *Chemical Engineering Transactions-7; Bulgarian Chemical Communications-3; Clean Technologies and Environmental Policy-2; Journal of Applied Mathematics and Mechanics-2; Journal of Chemical Technology and Metallurgy-1; Journal of Ecological Engineering-1; IOP Conference Series: Materials Science and Engineering (MSE)-1; Mechanics of Advanced Materials and Structures-1; Water and Environment Systems-1; Engineering Transactions-1; Journal of Applied and Computational Mechanics-1; Journal of Theoretical and Applied Mechanics-1; U. Porto Journal of Engineering-1.*

**In journals without an impact factor – none.**

**Reports from scientific forums, printed in full text – not presented.**

**Reports and posters at international events – not presented.**

The submitted 23 publications were cited a total of 53 times between 2014 and now. In total, the candidate has 154 citations for 37 (out of a total of 43) papers indexed in global databases since 2000; Hirsch factor-7. Although the IChE criteria for professor recommend a Hirsch factor of 8, Assoc. Prof. Petrova has 10 papers with 7 or more citations, of which 5 have 8 or more citations (i.e., she is missing a total of 3 citations of the 5 articles that already have 7 citations each, in order to reach a Hirsch factor of 8).

The listed 23 papers are distributed in journal quartiles as follows: Q1-2, Q2-8, Q3-7, Q4-5, and one of the journals is without a quartile.

Assoc. Prof. Petrova has been the lead for 2 projects funded by sources from Bulgaria (one from the National Science Fund 2021-2025, and one from the Ministry of



Education 2013-2013). She participated in 6 more scientific projects funded by Bulgarian agencies, in another 9 scientific projects funded from abroad (with researchers from Germany), and in 2 contracts with Bulgarian companies. (UNITECH OOD, Dalgopol). The involvement and participation in several contracts and scientific projects testifies to the candidate's extensive scientific and administrative experience.

Since 2012, Assoc. Prof. T. Petrova has been teaching laboratory and problem solving sessions in Theoretical Mechanics at the European Polytechnic University in Pernik, for both semesters each year. She has been the co-advisor of a doctoral student at IChE-BAS who successfully defended her thesis, as well as the advisor of two master's graduates at TU-Sofia. She has extensive experience in reviewing scientific proposals and papers, as well as significant scientific and administrative experience as the chairman of the colloquium of scientists at IChE-BAS (2018-present) and as the chairman of the scientific council of IChE-BAS (2024-present).

The main scientific interests of Assoc. Prof. Petrova lie in the field of modeling and optimization of gas and liquid flows in columns, mainly investigating the effects of uneven arrangement of the fillings in the column. Her research includes both theoretical considerations and numerical modeling, as well as collaborations with experimenters to perform measurements and obtain new data for testing the theoretical results. In parallel, Assoc. Prof. Petrova has worked on the modeling and optimization of composite and nanocomposite structures that are similar to those used in industrial applications. Her research included materials with and without defects subjected to static or dynamic mechanical loads, taking into account changes in the temperature or humidity and the effect of an applied electric field—the latter considerations allow for a connection between the theoretical results and real conditions. A third distinct direction in the work of Assoc. Prof. Petrova was the design of optimal resource-ensuring circuits under different scenarios and under different optimization criteria. Her work includes the formulation and solution of optimization problems that take into account different aspects of sustainability – environmental, economic, and social, under different imposed constraints (e.g. maximum environmental effect, maximum economic effect, etc.).

**The main scientific contributions** of Assoc. Prof. Petrova's work presented for this competition can be systematized as follows:

- Determination of the effects of non-uniformity in the initial distribution of phases in the flow of columns, as well as the effects of non-uniformities in the filling layer.

Experimental measures have been proposed to reduce the observed non-uniformity; a new method for determining the number and location of clusters in the column's filling has been developed; new criterion equations have been derived for determining the hydraulic resistance of dry and wetted fillings; the influence of gas flow hydrodynamics on heat and mass transfer has been modeled. (included in publ. 1, 2, 3, 8);

- An analytical solution for the flow rate of the liquid phase in a column has been obtained, and new methods for finding the parameters of the three-parameter dispersion model have been proposed. An improved design for feeder and collection devices has been proposed, and new experimental data have been obtained for three types of open-structure packings (included in publ. 4, 5, 6, 7, and 9);

- A 1D "shear-lag" model has been derived, with which several problems for the transfer of stress in bimaterial composite structures have been solved. Solutions for the displacements and stresses have been obtained, for different combinations and properties of the included materials. (publ. 10-15, 19, 20, 22, and 23);

- The model developed above has been used to assess the influence of various parameters (temperature, humidity) on the electrical gradient in composite structures; it



has been established that the frequency range of the dynamic load strongly affects the properties of the material and its adhesion to other materials; it was determined that under external loads the length of the overlap zone between the sensor and the substrate significantly influences the strength of the bond. The above results make it possible to give practical recommendations for the optimization of real systems (included in publ. 10-15, 19, 20, 22 and 23);

- The optimal product portfolio in a resource flow chain was obtained through optimization analysis of the production of a few dairy products; three scenarios were studied with different emphases on the economic, social, and environmental factors. (included in publ. 16,17,18, and 21)

- the radial distribution of a liquid phase (water) was determined following passage through a layer of unordered packings with an open structure in a pilot column; zones with large-scale unevenness were established; using a dispersion model, the non-uniformity of the liquid phase was estimated, using the authors' original experimental data as well as literature data; this was done in columns with second, third and fourth generation packings, both for pilot and industrial columns (publications 24 and 25).

#### CONCLUSION:

The application materials submitted by Assoc. Prof. Petrova for this competition meet or exceed (both in terms of volume and quality) the corresponding requirements described in 1) the Internal Regulations of IChE for academic growth, 2) the Regulations and procedures for acquiring scientific degrees and holding academic positions in the Bulgarian Academy of Sciences, 3) the Act on the Development of the Academic Staff in the Republic of Bulgaria and 4) the Regulations on the implementation of the latter Act. I therefore give my **positive assessment** of the candidate in this competition for the academic position of professor in professional area 4.2. Chemical Sciences (Processes and apparatus in chemical and biochemical technology). I hereby give my "Yes" vote to the scientific review committee to recommend to the Scientific Council of the Institute of Chemical Engineering that Assoc. Prof. Dr. Tatyana Petrova be confirmed as professor.

Sofia  
06.01.2025



(Prof. Maxim Boyanov)