

REVIEW

from assoc. prof. Petya Georgieva Popova-Krumova

regarding to a competition for holding the academic position "**Professor**" in professional field **4.2. Chemical Sciences "Processes and Apparatus in Chemical and Biochemical Technology"**, for the needs of the laboratory "**Transfer Processes in Multiphase Media**" of the Institute of Chemical Engineering at Bulgarian Academy of Sciences, announced in the state newspaper no. 77 (10.09.2024)

Candidate: **Assoc. Prof. Dr. Tatyana Stefanova Petrova**

1. Brief biographical data and description of the candidate's scientific interests

The candidate, Assoc. Prof. Dr. Tatyana Stefanova Petrova, was born on 01.10.1966. She graduated her higher education at Sofia University "St. Kliment Ohridski" - Sofia in 1989, she received a Master's degree in "Fluid Mechanics". In 1991 she was enrolled as a full-time postgraduate student at the Department of Mechanics of Continuous Media, Faculty of Mechanics, Sofia University "St. During the period 1991-1996 she passed all the necessary exams in the specialty, as well as in English and Russian languages. In 2006 she enrolled in a PhD program at the Institute of Chemical Engineering – BAS. In 2008 Assoc. Prof. Petrova received the PhD degree in scientific specialty 4.2. Chemical Sciences "Processes and Apparatus in Chemical and Biochemical Technology" with a dissertation entitled "Mathematical modeling of liquid and gas distribution in packed columns".

The scientific interests of Assoc. Prof. Dr. Tatyana Stefanova Petrova are in the field of engineering chemistry and are focused on the problems related to the flows distribution in column apparatus, mathematical modeling and optimization of composite and nanocomposite structures and design of optimal resource-supply chains (ROS) in the dairy industry.

Since 1996 the candidate has been working at the Institute of Chemical Engineering, Bulgarian Academy of Sciences, Sofia. In the period 1996-2005 she was "Research Associate III degree", from 2005 to 2008 - "Research Associate II degree" at the Laboratory of Heat and Mass Transfer Processes in Gas-Liquid Systems, and since 2011 she has held the position of "Associate Professor" in the same scientific organization. Assoc. Prof. Petrova is fluent in English, Russian and German.

2. General characteristics of the candidate's scientific research and applied scientific activity

The candidate in the competition for the academic position of Professor, Assoc. Prof. Dr. Tatyana Stefanova Petrova, has mainly scientific and applied activity.

Assoc. Prof. Petrova was a participant in four projects financed by the National Science Fund, Ministry of Education and Science of the Republic of Bulgaria (BNSF) under competitions for the funding of fundamental scientific research and the bilateral cooperation between Bulgaria and India. In the period 2000 - 2011 the candidate was a member of the team in a project under a framework contract with UNITEH Ltd - Dalgopol "Consultancy and technical assistance in the development of a rectification plant for the production of ethyl alcohol". In the period 2009 - 2011 she was also a participant in a project funded under the "Operational Program for Human Resources Development 2007-2013" of the European Union.

Assoc. Prof. Petrova is a participant in nine international projects with funding from DFG.

Assoc. Prof. Petrova is the leader of two projects:

- Project " Optimal safe loading and geometry for layered nanocomposites under thermo-mechanical loading", financed by the National Science Fund, Ministry of Education and Science of the Republic of Bulgaria (BNSF) under competitions for the funding of fundamental scientific research.
- Project funded under the Direct Grant Scheme of the Ministry of Education and Science, co-financed by the ESF-Support for scientific publications in high impact factor journals-reviewed and approved for publication.

In the period from 2012 to the present, the candidate has participated in the preparation and conducting of courses in Theoretical Mechanics 1 (summer) and Theoretical Mechanics 2 (winter)- for the 1st and 2nd year in English, specialty "Civil Engineering" and in the preparation and conducting of exercises in Mechanics in English, specialty "Green Energy".

Assoc. Prof. Dr. Tatyana Stefanova Petrova has prepared over 70 anonymous reviews for scientific journals and conference proceedings, has prepared reviews of project proposals and project reports for competitions of BAS, BNSF, MU-BAS, NNP "MU and postdoctoral students", as well as opinions for competitions for academic positions "professor" and "associate professor", and for competitions for PhD.

Assoc. Petrova is the supervisor of a PhD student Konstantina Stefanova, who has obtained her PhD degree in 2020 with a dissertation entitled " Investigation and modelling of hydrodynamics in a column with modern high-efficiency non-packed packings in the specialty "Processes and apparatus in chemical and biochemical technology".

The candidate also supervises two students:

- Ivan Kirov Georgiev, TU-Sofia, fac.No. M03000137, Theme of the diploma thesis - Study of gas distribution in columns with IMTP metal saddles;
- Ivo Tsvetanov Dimov, TU-Sofia, faculty No. M03000733, subject of the diploma thesis - Study of gas distribution in columns with plastic packings Raschig-Super Ring and Ralu-Flow, successfully defended July 2004.

Assoc. Prof. Petrova was a member of the organizing and scientific committees of 7 international and national scientific forums, organized and held in the period 2016 - 2023.

3. Evaluation of the presented materials

Assoc. Prof. Dr. Tatyana Stefanova Petrova is the only author of 6 scientific publications and co-author of 77 scientific publications and 2 book chapters. She participated in the competition as a co-author in 23 scientific publications and 2 book chapters. Nine of the publications are included in the extended habilitation reference (indicator C) and 14 publications and two book chapters under indicator D.

All scientific research submitted under indicator C has been published in journals refereed and indexed in Web of Science and Scopus databases. The distribution of articles according to journal rank expressed in quartiles (Q-factor) is as follows: Q2-3 publication, Q3-3 publication, Q4-2 publication and 1 publication in a journal with SJR. These publications give a total of 139 points out of a minimum of 100 points.

The distribution of other scientific and applied research, excluding the habilitation thesis, according to the rank of scientific journals is as follows: two book chapters, 2 publications in a journal with Q1, 5 in a journal with Q2, 4 in a journal with Q3, 3 in a journal with Q4. These publications give a total of 276 points out of a minimum of 220 points.

A list of citations in publications refereed in Scopus and WoS is presented (66 citations in total). These citations give a total of 132 points out of a minimum of 120 points, thus fulfilling the points for indicator groups E. The candidate for "Professor", Assoc. Prof. Dr. Tatyana Stefanova Petrova, has h index 7 (with a total number of citations in Scopus and WoS - 66).

The total number of points of the candidate in indicator F (supervision of a successfully defended PhD student, participation in a national and international scientific or educational project) is 180 with a minimum of 150 points.

When comparing the presented materials by Assoc. Prof. Petrova with the minimum requirements (Table 1) for the academic position "Professor" in Research field 4. Natural sciences, mathematics and informatics, professional field 4.2. Chemical Sciences, according to the Regulations for the application of the Law on the Development of the Academic Staff in the Republic of Bulgaria and the Regulations for the terms and conditions for academic positions in the Bulgarian academy of Sciences, it follows that the minimum requirements for applying the academic position "Professor" have been met.

Table 1. Minimum required points by groups of indicators for the academic position " Professor" and number of points of the candidate by individual indicators.

Indicators	Content/Indicator	Number of points of the candidate	Minimum required points for "Associate Professor"
A	1. Dissertation thesis for receiving PhD degree	50	50
C		139	100
	4. Habilitation thesis - scientific publications in referenced and indexed in world databases with scientific information (Web of Science and Scopus)	3-Q2 3-Q3 2-Q4 1-SJR	25 for public. in Q1 20 for public. in Q2 15 for public. in Q3 12 for public. in Q4 10 for public. with SJR without IF
D		276	220
	7. Scientific publication in referenced and indexed in world databases with scientific information (Web of Science and Scopus), outside of the habilitation thesis	2-Q1 5-Q2 4-Q3 3-Q4	25 for public. in Q1 20 for public. in Q2 15 for public. in Q3 12 for public. in Q4 10 for public. with SJR without IF
	8. Published book chapter or collective monograph	2x15	15
E		132	120
	11. Citations in scientific publications, monographs, collective volumes and patents, referenced and indexed in world databases of scientific information (Web of Science and Scopus)	66*2	
F		180	150
	13. Supervision of a successfully defended PhD student (n is the number of supervisors of the respective PhD student).	20	40/n
	14. Participation in a national scientific or educational project	2 x 10	10
	15. Participation in an international scientific or educational project	6 x 20	20
	16. Leadership of a national scientific or educational project	1 x 20	20

4. Basic scientific and scientific-applied contributions

The scientific and applied works presented by Assoc. Prof. Petrova are in the field of engineering chemistry and are focused on the problems related to the flows distribution in column apparatus, mathematical modeling and

optimization of composite and nanocomposite structures and design of optimal resource-supply chains (ROS) in the dairy industry.

Based on the materials submitted to me for review, I would summarize the candidate's scientific and applied contributions on the scientific topics as follows:

„Investigation and estimations of flow distributions in column apparatus“

For gas phase:

Quantitative estimates of gas flow distribution non-uniformity after different modifications of gas distribution devices and combinations of gas distribution devices with structured and unstructured packings in pilot and industrial apparatus are analyzed.

Three new criterion equations are derived to determine the hydraulic resistance of dry and wetted horizontal sheet packing (HFLP) as well as the gas velocity at the point of containment.

For liquid phase:

New methods for model parameters identification in a three-parameter dispersion model have been proposed, combining the model with non-uniformity estimates to allow for simulation and optimization of the design of the collection device under the packing, in order to account more correctly for the distribution of the liquid in the wall zone.

It is shown that the model parameters identification depends on the fragmentation of the collecting devices, especially in the column wall zone, where significant non-uniformity is observed.

The dispersion model has been successfully validated using in-house and literature experimental data and has been applied to describe the liquid phase distribution in pilot columns with open-structure packings.

An experimental setup has been designed and built, with a new design of uniform liquid aerator and added peripheral aerator.

„Modelling and optimization in composite and nanocomposite structures“

An analytical 1D "shear-lag" model has been proposed to solve several problems of stress transfer in bimaterial composite structures under static or dynamic mechanical loads and under the influence of an electric field and/or changes in ambient temperature and humidity.

A new analytical equation for the resonant frequencies is proposed, where the resonant frequency depends on the densities, Young's moduli and thicknesses of the layers as well as the shear modulus of the adhesive.

A new multi-parameter optimization procedure containing the corresponding model criterion for minimum/zero delamination at the interface as an objective function is developed. The optimization was performed by nonlinear programming with a genetic algorithm and the optimal values of the geometry of the composite structures and the values of the external influences at which the no delamination criterion is satisfied were simultaneously determined.

A new two-dimensional "stress-functional" method is proposed to describe the tension transfer in three different three-layer nanocomposite structures (single and multilayer graphene/epoxy/PMMA, and WS₂/SU-8/PMMA).

„Design of optimal resource-supply chains (ROS) in the dairy industry“

A mixed-integer nonlinear programming model is proposed for the optimal design of a sustainable resource-supply chain (RSSC) for the production of various dairy products, and the approach incorporates dairy production models along with the economic, environmental, and social impacts on the considered RSSC. A stochastic optimization approach is developed to deal with uncertainty in product requirements in a ROV for the production of different dairy products under different technologies, different number of suppliers and different number of markets while satisfying environmental, economic and social criteria.

A new optimization approach is developed to manage the uncertainties in product requirements in ROVs for the production of different dairy products using different technologies, with simultaneous consideration of economic, environmental and social criteria.

“Investigation of liquid phase non-uniformity processes in column apparatus with high-efficiency random packings”

The non-uniformity of inlet and outlet flows from the column packing layer was experimentally investigated. Areas of large-scale non-uniformity in the column are identified and solutions are proposed to describe and estimate it.

A dispersion model is developed and its capabilities for modeling the radial distribution of the liquid phase after an open-structure packing layer are presented. The model parameters are analyzed and methods for their determination in different situations are proposed, depending on the available experimental data and the conditions under which they are obtained. Verification of the proposed model, its parameter identification methods and the selection of the optimum packing design, as well as quantitative estimates of the liquid phase non-uniformity, has been performed using in-house and literature data for second, third and fourth generation packed columns for pilot and for industrial columns.

The results obtained by Assoc. Prof. Tatyana Stefanova Petrova are both fundamental and scientifically applied.

5. Reflection of scientific publications in the literature.

There are 66 citations in scientific journals, monographs, collective volumes and patents, refereed and indexed in databases with scientific information (Web of Science and Scopus), thus the points for groups of indicators E are satisfied. The total number of the candidate's citations is 165, which indicates a high reflection of scientific publications, both in the foreign literature and in our country.

6. Critical notes and recommendations.

I have no critical remarks to make about the candidate. The competition documents are formatted according to the requirements and contain comprehensive information on the results and scientific contributions of the candidate.

7. Personal impressions of the reviewer about the candidate.

I have known Assoc. Prof. Dr. Tatyana Stefanova Petrova since she worked at the Institute of Chemical Engineering at BAS. Over the years she has established herself as a conscientious and competent specialist in the field of her scientific interests.

Assoc. Prof. Petrova is currently the Chair of the Colloquium of Scientists and the Chair of the Scientific Council at the Institute of Chemical Engineering-BAS, which is an indication of her outstanding leadership and organizational skills, and ability to work in a team on joint scientific projects and tasks.

CONCLUSION

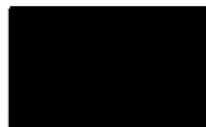
The publications presented by Assoc. Prof. Dr. Tatyana Stefanova Petrova are on the topic of the competition and represent original scientific developments with significant contribution in the field of processes and apparatus in chemical and biochemical technologies.

Based on the above, I consider that the candidate in the present competition for the academic position "Professor"- Assoc. Prof. Dr. Tatyana Stefanova Petrova, fully satisfies the minimum requirements for the academic position "Professor" in the professional field 4.2. Chemical sciences, according to the Regulations on the conditions and procedure for the acquisition of scientific degrees and academic positions at the Bulgarian Academy of Sciences, as well as the additional requirements of the Institute of Chemical and Chemical Engineering-BAS for the academic position "Professor".

Based on the attached documents, I propose the Scientific Jury and the Scientific Council of the Institute of Chemical Engineering-BAS to award the scientific position "Professor" to Assoc. Prof. Dr. Tatyana Stefanova Petrova in the professional field 4.2. Chemical sciences, scientific specialty "Processes and apparatus in chemical and biochemical technology".

Date:06. 01. 2025

Reviewer:



/Assoc. Prof. Dr. Petya Popova-Krumova/