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## STANDPOINT

by Assoc. Prof. PhD Stanislava Metodieva Andonova

Institute of General and Inorganic Chemistry - BAS

**About: Competition for occupying the academic position an Associate Professor in a professional field 4.2. "Chemical Sciences", scientific research specialty "Chemical kinetics and catalysis" code 01.05.16, for the needs of the Department of Chemical Technologies, Faculty of Technical Science at "Prof. D-r. Assen Zlatarov" University-Burgas, announced in Official Gazette No. 95 of 16.11.2022.**

Assist. Prof. Dr. Ivaylo Gerogiev Tankov is the only candidate in the announced competition. All documents, required and specified by "The Regulations for the Terms and Rules for Occupation of Academic Positions at "Prof. D-r. Assen Zlatarov" University-Burgas have been duly submitted.

### **Brief details of the applicant**

Assist. Prof. Dr. Tankov has received his Master's degree in 2007 at "Prof. D-r. Assen Zlatarov" University- Burgas, with qualification "chemist-engineer" in the field of organic chemistry, production and processing of polymers, chemistry and technology of oil, gas and lubricants. From 2007 to 2009 he worked as a chemist at "Solimex", Burgas for production of inorganic salts and later at Aquapark "Sunny Beach", Burgas for analysis of the quality and the chemical parameters of water in swimming pools. In the period 2009-2012 he was a PhD student at Institute of Catalysis, Bulgarian Academy of Sciences (BAS) where in 2012 he obtained the educational and scientific degree "Doctor" in the scientific specialty "Chemical Kinetics and Catalysis", with dissertation titled: "Synthesis and characterization of catalysts for reforming of methane". In 2013 he worked again for shortly as a chemist at Spa Design Bulgaria, Burgas. In the period 2007-2015 Dr. Tankov won a competition as an Assistant and then Chief Assistant Professor at the Department of Chemical Technologies, Faculty of Technical Science at "Prof. D-r. Assen Zlatarov" University- Burgas and since then he works in this position.

### **Evaluation of teaching activities**

The presented materials about the teaching activity of the candidate are a proof of the high professional competencies in the field of higher education and master's/bachelor's degree preparation at the university. This is evidenced by the number of lectures (8 different disciplines for 2020/2021; 4 for 2019/2020; 2 for 2017/2018; 3 for 2016/2017) and practical exercises (12 different disciplines for 2020/2021; 6 for 2019/2020; 6 for 2016/2017; 9 for 2016/2017; 9 for 2015/2016 and 7 for 2014/2015) given in the field of reaction kinetics and catalysis, basic organic synthesis, engineering solutions for clean and safe technologies etc., as well as his participation in the training of graduate students (4 in the period 2015-2019) and his co-authorship in the development/renewal of many teaching programs (13 for 2017-2021).

Certificate for the high professional qualities of Dr. Tankov is his co-authorship in the university book titled "Quantitative study of chemical reactions in petrochemical synthesis" (ISBN: 978-619-7123-79-1, Burgas), published in 2018 for students, PhD students and specialists working in the field of chemical and refining industries.

#### **Evaluation of scientific research activities**

Impressive and no less is the contribution of Dr. Tankov to the scientific research activity at the university. It comprises 30 scientific works published in the period 2016–2022, all referenced and indexed in the world-famous scientific information databases (Scopus/Web of Science).

In the present competition, Dr. Tankov participates with 15 scientific papers, published in the period 2017–2022 in reputable high impact factor international journals. Nine of these articles are in journals indexed with the highest category Q1 and six with Q2, all included in the WoS or Scopus database. In the section "Habilitation work - scientific publications in journals that are referenced and indexed in world-famous scientific information databases (WoS or Scopus)" are presented 5 publications, covering B-3 and B-4 indicators, with totally 120 points of the required 100 points. To the "Scientific publications in journals that are referenced and indexed in Web of Science and Scopus, outside the habilitation work" are presented 10 articles, 1 published book, a utility model and 1 patent application covering the G-7-10 indicators, with a total of 245 points. Dr. Tankov as co-author in his publications has 143 citations (Scopus). The H-index of the applicant according to the Scopus database is 7 (excluding self-citations of all authors). The leading personal contribution of the candidate in the research activity and interpretation of the scientific results is confirmed by the fact that Dr. Tankov is first author in 13, and second in 2 of the presented publications.

According to the submitted materials, the candidate has participated in the implementation of 4 research projects on various topics with different sources of funding, including the National Science Program funded by the Ministry of Education and Science. The candidate in this competition, for each of the scientific indicators, completely fulfilled and even exceeded the requirements of occupation of the academic position "Associate Professor" at "Prof. D-r. Assen Zlatarov" University- Burgas.

#### **Evaluation of the scientific work**

The overall research activity included in the habilitation of the applicant Dr. Tankov is focused on the development and characterization of new efficient and promising homogeneous and heterogeneous catalysts for esterification and thus respectively for production of environmentally friendly fuels (biodiesel). The publications are thematically grouped in four main topics: (i) Synthesis of new ionic liquids and study of their composition and structure; (ii) Analysis of surface phenomena occurring in heterogeneous ionic liquids; (iii) Kinetics of thermal decomposition of ionic liquids and (iv) The application of new ionic liquids as effective catalysts for esterification. The main scientific achievements can be summarized as follows:

The studies conducted by the applicant in the first topic are focused on the synthesis and characterization of different ionic liquids based on pyridinium hydrogen sulfate (PHS), pyridinium dihydrogen phosphate (P2HP), pyridinium nitrate (PN), 4-amino-1H-1,2,4-triazolium nitrate (ATN) and tris(2-amino-1,3-thiazolium) hydrogen sulfate sulfate monohydrate (TAHSSM). The research has been conducted using a wide range of

instrumental methods for physicochemical characterization and quantum chemical analysis. Thus, the molecular geometry of the ionic liquids has been described and for the first time the aromaticity of an inorganic anion in the structure of some of them has been documented. Based on these results, heterogeneous systems (PHS/ $\text{Al}_2\text{O}_3$ , PHS/RHA, xPHS/AC and TAHSSM/ $\text{Al}_2\text{O}_3$ ) were further obtained using different supports as  $\text{Al}_2\text{O}_3$ , rice husk ash (RHA) and activated carbon (AC).

The publications included in the second topic are related to the analysis of the surface phenomena occurring in heterogeneous ionic liquids. For the first time the vibrational relations in the ionic liquids PHS and TAHSSM and the heterogeneous systems obtained on their basis - PHS/ $\alpha\text{-Al}_2\text{O}_3$ , PHS/RHA TAHSSM/ $\alpha\text{-Al}_2\text{O}_3$  and xPHS/AC were studied. The nature of the surface interactions in PHS/ $\alpha\text{-Al}_2\text{O}_3$ , PHS/RHA, TAHSSM/ $\alpha\text{-Al}_2\text{O}_3$  and xPHS/AC as a function of the nature of the supports has been clarified. The spatial location of the immobilized active phase on the support surface in the heterogeneous systems PHS/ $\alpha\text{-Al}_2\text{O}_3$ , PHS/RHA and xPHS/AC has been established.

The third topic includes studies related to the kinetics of thermal decomposition of the ionic liquids. For the first time, the thermal behavior of PHS, P2HP and PN and the heterogeneous PHS/ $\alpha\text{-Al}_2\text{O}_3$  and PHS/RHA systems obtained on their basis was studied. The mechanisms of melting and decomposition of the samples as a function of the degree of intramolecular hydrogen bonding and the nature of the supports have been established. The kinetics of thermal decomposition of pyridinium nitrate was studied for the first time. The mechanism was found to include a step of rupture of intramolecular hydrogen bonds with the formation of  $\text{C}_5\text{H}_5\text{N}$  and  $\text{HNO}_3$ .

The last fourth topic describes the catalytic behavior of pure ionic liquids PHS, P2HP, ATN, TAHSSM and PN and the heterogeneous systems PHS/ $\alpha\text{-Al}_2\text{O}_3$ , PHS/RHA and PHS/AC in the production of n-butyl acetate and methyl oleate (biodiesel). The mechanism of butyl acetate production by the formation of an active complex involving ionic liquid (PHS) as a catalyst has been shown for the first time. Based on detailed kinetic and thermodynamic analysis, the optimal conditions for the production of butyl acetate and methyl oleate in the presence of the ionic liquids PHS, ATN and PN were determined.

A common feature of Dr. Tankov's research activity in the various topics is his adequate combination and use of different methods of physicochemical characterization and quantum chemical analysis. In this way, it has allowed to be studied comprehensively fundamental aspects related to the molecular geometry of various ionic liquids, their application as catalysts for esterification and analysis of the kinetic and thermodynamic parameters of the process. The studies included in the competition have been published in journals with a high impact factor, some of which are among the most respected in the field of molecular modeling and catalysis: *Journal of Molecular Liquids*, *Journal of Molecular Structure*, *Spectrochimica Acta Part A: Molecular and Biomolecular Spectroscopy*, *Fuel*, *Catalysis Letters*.

Based on the documents submitted to the current competition, I can define Dr. Ivaylo Tankov as a young and active scientist with great potential who is able to conduct systematic research and to carry out in-depth analysis of the collected data. The scientific achievements in the studies are indisputable and correctly presented. They are mainly focused on finding new innovative approaches for production of environmentally friendly fuels by developing new efficient and promising homogeneous and heterogeneous catalysts for this purpose.

## CONCLUSION

The documents and materials presented by Assist. Prof. Dr. Ivaylo Gerogiev Tankov meet all the requirements of the Law for the Development of the Academic Staff in the Republic of Bulgaria, the Regulations for its implementation and the corresponding rules for the implementation of the law at "Prof. D-r. Assen Zlatarov" University- Burgas.

The high professional qualities in the teaching activity of Dr. Tankov, as well as the high scientific indicators and the contributions from his research activity fully correspond and exceed the set of obligatory conditions and criteria of occupation of the academic position "Associate Professor" at University "Prof. Dr. Asen Zlatarov "- Burgas. The scientific research is at a high level and fully corresponds to the topic of the announced competition in the professional field 4.2. "Chemical Sciences", scientific research specialty "Chemical kinetics and catalysis".

**Therefore, I convincingly recommend to the members of the Scientific Jury and to the Scientific Council of the Faculty of Technical Science at "Prof. D-r. Assen Zlatarov" University- Burgas, to award to Assist. Prof. Dr. Ivaylo Gerogiev Tankov the Academic Position "Associate Professor" in the field 4.2. Chemical Sciences, scientific research specialty "Chemical kinetics and catalysis".**

Sofia, 15.02.2022 г.

Member of the Scientific Jury:.

/Assoc. Prof. Dr. Stanislava Andonova, IGIC-BAS/