

R E P O R T

on the competition for the academic position Professor scientific direction 4.2. Chemical Sciences (physical chemistry)

Institute of Physical Chemistry at the Bulgarian Academy of Sciences (IPC-BAS)
announced in ДВ, No 20 / 10.03.2020

Applicant: **Assoc. Prof. Dr. Dragomir Mladenov Tatchev** (IPC-BAS)

Member of the Scientific Jury: Prof. Dr. Radostina Konstantinova Stoyanova (IGIC-BAS)

A. Short professional biography

Dr. Dragomir Tatchev is the only applicant in the competition announced by IPC-BAS for the academic position Professor on Chemical Sciences (physical chemistry). He is a graduate of the Faculty of Physics at Sofia University and in 1995 he defended his master's degree in engineering physics and microelectronics. In 1996 he became a member of the Institute of Physical Chemistry (BAS), where in 2005 he successfully defended the thesis on the processes of crystallization in a subeutectic amorphous alloy of nickel and phosphorus. This is the period, in which the research activities of Dr. Tatchev are directed to the field of physical chemistry. An important stage for the affirmation of Dr. Tatchev's research in the new scientific field is his specialization at the Humboldt University in Berlin, the Faculty of Chemistry (Germany) and the Helmholtz Center for Materials and Energy (Berlin, Germany). The acquired new knowledge Dr. Tatchev successfully applies and develops during the advancement of the new equipment X-ray microtomograph in IPC-BAS. In 2010 he was habilitated as a senior research at IPC-BAS, equated to associate professor in accordance with the law from 2010. This report clearly shows that the research activities of Dr. Tatchev fully comply with the requirements of the competition announced in IPC-BAS for Professor of Chemical Sciences (Physical Chemistry).

B. Report on the fulfillment of the minimal criteria of BAS

Dr. Tatchev is a co-author of a total of 49 scientific papers. In the competition for professor he with 12 scientific publications, summarized as a habilitation thesis. They are devoted to the theory of small-angle X-ray and neutron scattering and the application of this theory to the study of microstructure in multiphase systems. Among them, five publications (i.e. 41.7%) were published in peer-reviewed journals from the second quartile of the respective area. Along with them, Dr. Tatchev presents 11 scientific papers, where the complementary application of small-angle scattering with X-ray computed tomography is demonstrated in order to monitor the processes of deposition/crystalization of metal particles and intercalation of anionic groups. It is important to note that 10 of the publications (i.e. over 90%) have been published in peer-reviewed journals from the first quartile in the field of materials science. After 2009, the successful development of Dr. Tatchev's research is directly related with his active participation in projects (14 in total) with various financial sources, such as NSF, National Operational Programs, Ministry of Education and Sciences and bilateral cooperation. Dr. Tatchev's research in a most convinced way that the Scientific Jury to award Dr. Olya Stoilova the academic position of Professor on ch has a wide response in the

international literature, and so far 488 independent citations have been noticed on all his publications (according to SCOPUS and Web of Science databases). Among them, 27 citations are indicated on the papers summarized as habilitation thesis, and 220 on the publications outside the habilitation thesis, with which Dr. Tatchev participates in the competition.

The report's data reveal that the scientific output of Dr. Tatchev is on the subject of the competition and meets the minimal national requirements for the academic position "Professor" in the field of "Natural Sciences, Mathematics and Informatics", direction on Chemical Sciences, specified in The Law for Development of the Academic Staff in Bulgaria, the Regulations for its application and the Regulations for the conditions and the order for acquiring scientific degrees and holding academic positions in BAS.

C. General features of the applicant's research activities

C1. Main scientific contributions presented in the habilitation thesis. Understanding the micro-texture and micro-morphology of multicomponent systems is a challenging scientific task in terms of creating an appropriate mathematical model. In general, this is the area, in which the research of Dr. Tatchev can be attributed. A theory on X-ray scattering of a multiphase system is proposed, as the mathematical equations can be reduced to those used in practice (including for two-phase systems) depending on the indicated approximations and assumptions. Some of the equations concerning the volume fraction have been used by Bokel and co-authors for in-situ monitoring of changes in the morphology of efficient organic photovoltaics (Bokel et al., Chem. Mater. 29 (2017) 2283).

The subjects of study by small-angle X-ray and neutron scattering are several multicomponent systems, such as spinel nanoparticles in oxide glasses, deposition of platinum or nickel on biocompatible polymers, platinum catalysts supported on carbon and / or TiO₂. For a given object a corresponding protocol has been drawn up, which makes it possible to determine simultaneously the size distribution of metal or oxide nanoparticles and their average composition. The gained information from these studies is needed to unveil new relationships between the method of synthesis and the catalytic / magnetic properties of multicomponent systems. Also, knowledge of the shape and manner of metal deposition on laser-irradiated biocompatible polymers is directly related to the creation of eye implants to restore vision.

In conclusion, Dr. Tatchev's research on the micro-texture and micro-morphology of multicomponent systems is an indispensable part of the overall range of complete study of materials, the originality consists in the advancement of mathematical functions to describe the small-angle scattering of single phases and from grain boundaries.

C2. Scientific contributions presented in the non-habilitation thesis. Research in this group focuses on the study of multicomponent systems by combining small-angle scattering with several complementary methods such as X-ray computed tomography, X-ray diffraction, DSC, and analytical ultracentrifugation. The combination of these techniques allows, on the one hand, to validate the methods and, on the other, to interpret the obtained results with a high degree of reliability. This approach is well demonstrated in the study of the capacity loss during the reversible charging/discharging of aluminum-ion battery, considered as a competitive alternative to lithium-ion batteries. The significance of this approach is disclosed in a wide range of application such as studying the crystallization in yttrium-zirconium layers upon their thermal annealing at high temperatures, the speciation of copper ions during insertion into silicoaluminophosphate, the trapping of metal or oxide particles in

protein molecules, the distribution of gold particles in sodium-calcium glasses. All these studies were conducted in a team with scientists from IPC-BAS, UCTM-Sofia, Belgium and Germany, and the role of Dr. Tatchev is well defined: he participates in the implementation of scientific tasks for the characterization of multicomponent systems and in formulation of new directions in investigations.

D. Conclusion

The main features of the overall research activity of Dr. Dragomir Tatchev is the systematic and purposeful application of small-angle scattering for analysis of the micro-texture and micro-morphology of heterogeneous structures and materials. The research clearly outlines the contribution of Dr. Tatchev, namely the methodological development of small-angle scattering methods outside their standard application for two component systems, and the results of these studies can serve as guidelines for the rational use of these methods in the study of various complex multicomponent systems. The scientific output of Dr. Tatchev exceeds the minimal national requirements for academic position of "Professor" in the field of "Natural Sciences, Mathematics and Informatics", direction of Chemical Sciences. Based on all mentioned criteria, I propose in a convinced way that the Scientific Jury to award Dr. Dragomir Tatchev the academic position of Professor on Physical Chemistry.

22.09.2020 г.

Radostina Stoyanova

