

REVIEW

re. competition for “PROFESSORSHIP” in Rank 4 Natural Sciences, Mathematics and Informatics; professional class 4.2 Chemical Sciences, Electrochemistry (incl. chemical power sources) for the needs of division “Electrochemistry and Corrosion” at the Institute of Physical Chemistry “Acad. R. Kaishev” – BAS, published in SP, issue 20 on March 10, 2020. The only participant in this competition is assoc. prof. Dr. Dragomir Mladenov Tachev.

1. Common and biographical data on the candidate

Assoc. prof. Tachev was born in July, 1971 in Sofia. He received his Master’s degree in “Engineering Physics and Microelectronics” from the Department of Physics, Sofia University “St. Kliment Ohridski” in 1995. He joined IPC-BAS in 1996 as a “physicist”. In 2005 he completed his 01.05.05 Doctorate in Physical Chemistry at IPC-BAS. In 2006 he became senior scientist II/associate professor at IPC-BAS. He was a postdoctoral scholar at Humboldt University, Berlin (2006-2007) and the Helmholtz Center for Materials and Energy, Berlin (2007-2009).

2. Overview of received materials

Assoc. Prof. D. Tachev has prepared a tabulated Summary for met minimal national requirements, according to BAS guidelines as well as the guidelines determined by the Scientific Advisory Board of IPC as of May 15, 2019. From the presented Summary, candidate substantially exceeds the requirements for “PROFESSORSHIP” across all indicators (A, B, C, D and E).

Assoc. Prof. D. Tachev participates in the competition with a body of scientific work that has been published in leading and relevant, specialized international and national journals and forums, having received high marks from experts in the field, as evidenced by the provided list of references and citations. The provided documents for participation in the competition include: publications equivalent to habilitation treatise - 12 ct.; publications in specialized scientific journals that do not repeat work associated with acquisition of Doctoral degree or Associate Professorship – 34 ct.; list of all publications - considered on overall merit.

The above-mentioned accomplishments are characterized quantitatively as follows, according to the requirements of t. 1, p. 1 of the “Guidance for the conditions and regulations for the acquisition of scientific degrees and academic appointments at IPC-BAS”:

- a) Total number of publications – 49, one being a book chapter (published by IntechOpen Publishing House, 2020). The candidate is an author on two of the publications, first author on 13, second author in 7.

I would also add two more of Assoc. Prof. Tachev’s publications – his doctoral dissertation on the topic of “Primary crystallization in a subeutectic amorphous Nickel-Phosphate alloy”, as well as the author’s summary of the dissertation, since this is scientific work that has been thoroughly reviewed by highly qualified and established experts in the field of the present Competition. Such qualification is also supported by the Intellectual Property Law of the Republic of Bulgaria.

b) Articles published in Impact Factor scientific journals – 39, including 23 in group Q1 journals, 9 – in group Q2, 3 – in group Q3 and 4 – in group Q4 (including a book chapter, as already noted above). The publication journals are among the highest rated, specialized, international editions (Electrochemical and Solid State Letters, Journal of Non-crystalline Solids, Journal of Applied Crystallography, Physica B: Condensed Matter, Nanotechnology, Journal of the American Chemical Society, Journal of Applied Physics, Physical Chemistry Chemical Physics, Electrochimica Acta, Journal of the Electrochemical Society, Surface and Coatings Technology, Journal of Material Science, Applied Surface Science, etc.);

c) Full-text publications printed as presentation materials for meetings, conferences and symposia with national and international participation – 9 ct.

d) Author's summary of his doctoral dissertation

e) Total citation count (Scopus and Web of Science) – 488; Hirsch index – 13.

I would point out that the candidate's specialized scientific journals publications that do not repeat work associated with acquisition of Doctoral degree or Associate Professorship number 34, out of 49. Thus, the candidate's scientific production exceeds the quantitative criteria for a "Professorship" under the "Guidance for the conditions and regulations for the acquisition of scientific degrees and academic appointments at IPC-BAS". The candidate has also provided a list of presentations at professional national and international scientific forums (13 ct). There is also a short summary of the candidate's participation in collaborative research projects as part of international contracts and agreements (EBR) – 12 ct.

All listed publications and activities of Assoc. Prof. D. Tachev fall entirely within the scope of the current competition.

3. Overall assessment of the candidate's scientific and applied work

Assoc. Prof. D. Tachev's scientific and applied work encompasses three major aspects:

The first aspect is in the field of investigation of the formation and/or characterization of a nanometric phase in various media and materials. This work encompasses a series of systematic experimental investigations that the candidate initiated at the beginning of his career and continues to pursue to date. It utilizes small-angle X-ray or neutron scattering to study the primary crystallization of nickel in a model subeutectic amorphous nickel-phosphorus alloy. The work was subsequently extended to include: 1) gold particles in sodium-calcium glass; 2) crystallization products ($Mn_xFe_{1-x}Fe_2O_4$ particles) in oxide glasses; 3) Protein (Apo ferritin or ferritin-like molecules) active site binding by oxide (Fe_3O_4 - γFe_2O_3) or metal (Pt, CoPt, Pd, CdS, CdSe, ZnSe, etc.) particles;

The second aspect is in the theory of small-angle X-ray scattering in multiphase systems. Assoc. Prof. D. Tachev has developed a novel theory of small-angle X-ray scattering in multiphase, multi-component systems. The work has been published in two single-author articles in the highly regarded Philosophical Magazine (2008, cited 13 times so far, twice by monographs) and Journal of Applied Crystallography (2010, cited 4 times so far)

The third aspect of Assoc. Prof. D. Tachev's work consists of the application of his deep and encompassing theoretical knowledge and experimental skill in the fields of physics and chemistry. It has to do primarily with the practical application of the various X-ray methods

mentioned above, as well as the utilization of the X-ray computed tomography machine that was recently purchased by IPC-BAS. Using these methods, he has collaborated and successfully completed a number of broad spectrum investigations of scientific and applied interest to colleagues at IPC-BAS, as well as a number of external institutes and organizations.

4. Main scientific and applied contributions

Essentially all materials submitted by the candidate fall in the category of topic priority No1 for IPC-BAS, as related to the generation and characterization of novel materials and technologies based on electrochemically obtained metal, alloy and modified coatings with protective, decorative and electrocatalytic properties. Along these lines, Assoc. Prof. D. Tachev's major contributions can be summarized as follows:

1. A highly sensitive thermo-magnetic method has been developed, and the results have been compared to DSC and DLM measurements [2,4,6]. The method has proven superior accuracy for samples characterized by primary crystallization of nickel in subeutectic Ni-P alloy, due to its instantaneous result measurement.

2. It has been demonstrated (using small-angle X-ray scattering at the DESY light source in Hamburg) that the "traditional" method of maximal entropy for the study of Ni precipitation in Ni-P alloy is sufficient to solve the integral equation that determines the size of the spherical particles [5,8,9,11,13]. Simultaneous analysis of several scattering curves via several size distributions has been achieved. A method has also been established to determine the average particle composition and/or the dependence of particle composition on particle size, along with their size distribution and the matrix composition.

3. A method has been established for the concurrent determination of particle size and composition distribution, on the basis of which it has been found that the smallest released particles are not made of pure Ni as one might expect from the equilibrium phase diagram, but rather contain up to 14 atomic % Ni, which they release during their growth [13].

4. SAXS results indicate that the kinetics of Ni release in the amorphous matrix are well aligned with the general crystallization theory of Kolmogorov and Avrami. Meaning – SAXS data enable the direct determination of the "nucleation sites vs. time" curve, from which in turn one can determine the rate of nucleation and growth [26].

5. A closed form equation has been proposed for the scattering invariant for a multicomponent, multiphase sample. A theory has been proposed that allows the determination of SAXS measurement schemes utilizing several absorption faces and their determination as a minimal set of energies at which the measurements should be taken. The theory utilizes partial structure factors during analysis of SAXS data. It has been clearly validated by experimental results for an $Al_{89}Ni_6La_5$ alloy [5]. The theory is universal and can be applied to any arbitrary method for contrast variation [19,25]. Accurate approximations have been defined at which the equations for an n-component system approach experimentally determined values.

6. In this point I will mark just a few of the candidate's contributions to areas outside of his primary focus via his routine scientific work, all of which stem from his impressive

theoretical and experimental skills. Though with his typical humble attitude Assoc. Prof. D. Tachev does not underscore these accomplishments (they are listed as “on the side” investigations in his list of contributions), they are impressive and equivalent in contribution to those of the co-authors on more than 15 publications [3, 7, 10, 15, 27, 36, 37, 39, 40, 41, 42, 43, 44, 45, 48, 49]. These articles include results from his investigations of X-ray computed tomography of laser treated and chemically coated with Ni and Pt biocompatible polymers, Al-ion batteries, baby teeth, It-Zr layers treated at temperatures up to 1000oC, SAXS study of a urea silicate polymer, and small angle neutron scattering of rocks from Antarctica.

5. References of the candidate’s scientific publications in the Bulgarian and international literature

Assoc. Prof. D. Tachev’s publications have been cited 488 times so far. By this metric, the candidate substantially exceeds the existing requirements for “Professorship”, per the law for academic career growth in RB and the IPC-BAS Guidance for its application.

6. Critique and recommendations for the candidate’s scientific work.

I have no critical remarks on the candidate’s scientific work. Besides my excellent overall impression on the documents submitted for this competition, I would make the following recommendations to the candidate:

- Drive the organizational aspects of his scientific and applied investigations towards establishing collaborations with EU partners, specifically aiming to participate in projects financed by the EU. He already has a well-established reputation in Europe.
- Attract young scientists and students, instruct them and include them in the scientific research in the laboratory he supervises. His potential for that is more than sufficient.

7. Personal impressions of the candidate


I know Assoc. Prof. D. Tachev personally and very well. We have worked at the same division at IPC for 25 years, and I have directly witnessed his scientific growth. Over all these years, he has been an example of a well-trained scientist out of university, who has proven himself in an unquestionable and stellar fashion. His natural exceptional intellect and finesse have enabled him to shine as a responsible, ethical, collaborative, serious, systematic and inquisitive scientific investigator.

CONCLUSION

My thorough review of the provided documents and materials for this competition have once again confirmed my opinion that Assoc. Prof. D. Tachev is a fully accomplished, highly qualified expert in the field of physical chemistry and physical methods of analysis, who has successfully combined the characteristics of an investigator – a theoretician and an experimentalist. His above-mentioned contributions attest to his encompassing training, his ability to methodically focus on and solve fundamental and applied problems which have direct impact on the theory and application of the formation of nanometric mono- and polyphasic systems in various media and materials, as well as their characterization by X-ray methods. He has a clearly defined scope of contribution in this field and has established himself as a leading and internationally recognized expert, who has contributed to the maintenance and enhancement of the reputation of IPC-BAS.

In volume. quality, scientific and applied contributions and by scientific metrics, the candidate's accomplishments completely satisfy and substantially exceed the requirements by law for a "Professorship" under the "Guidance for the conditions and regulations for the acquisition of scientific degrees and academic appointments at IPC-BAS". On the basis of all points made above, with deep conviction, I am pleased to recommend to the respected members of the Scientific Review Committee that they grant Assoc. Prof. Dr. Dragomir Mladenov Tachev the academic title of "PROFESSOR", professional class 4.2 Chemical Sciences, Electrochemistry (incl. chemical power sources) for the needs of division "Electrochemistry and Corrosion" at the Institute of Physical Chemistry "Acad. R. Kaishev" – BAS. I have no doubt that his becoming a "PREOFESSOR" will not only recognize the results and contributions of his scientific work, but will also be an investment in the future of continued establishment and development of department "Electrochemistry and Corrosion" at IPC-BAS.

Reviewer -


(Professor D. Stoychev, PhD, DSci)

13.09.2020
Sofia