

OPINION

on a completion for the occupation of the academic position "Professor",
in professional field 4.2. Chemical Science, scientific specialty "Physical Chemistry"
announced in Bulgarian SG No. 107/20.12.2024

Candidate: Svetlosar Dimitrov Ivanov, PhD, Assoc. Profesor

Member of the scientific jury: Boriana Rangelova Tzaneva, PhD, Professor,
Department of Chemistry, Technical University of Sofia

1. Overall characterization of the research and applied scientific activities of the candidate

The results of the scientific research of Assoc. Prof. Ivanov have been published in 65 scientific papers, including 47 publications in high-impact journals, 4 book chapters, 2 patents and 12 conference full papers, and the total number of citations noted by the candidate is 1056.

In the competition for the academic position of "Professor", the only candidate Assoc. Prof. Ivanov, participated with the following points:

- **indicator A** - 3 publications in Q1 and 3 publications in Q2, equal to 135 points at requirement of 50 points;
- **indicator B** - 3 publications in Q1 and 3 publications in Q2, equal to 135 points at requirement of 100 points;
- **indicator Г** - 6 publications in Q1, 2 publications in Q2, 2 published book chapters and 2 patents, equal to 250 points at requirement of 220 points;
- **indicator Д** - 63 citations in publications referenced in world-renowned databases, equal to 126 points at requirement of 120 points;
- **indicator E** - co-supervisor of three doctoral students, participation in two national and two international scientific projects and leadership of a team in an international project, and the funds for the projects measure 790 thousand BGN, in total 343 points at requirement of 150 points.

The publications included in indicators B and Г do not repeat those from previous procedures. Considering all requirements, the candidate exceeds them all, even achieving doubling of indicator E. In addition to scientific work, it is worth noting the teaching activity of Assoc. Prof. Ivanov as co-supervisor of three successfully graduated PhD students and leading courses on "Electrochemistry and Corrosion" and "Electrocrystallization" for bachelors and masters respectively at the Technical University of Ilmenau.

2. Main scientific and applied contributions

The scientific research of Assoc. Prof. Ivanov is focused on important and contemporary areas such as the development and analysis of new materials for electrochemical energy conversion and energy storage. They are characterized by a thorough scientific approach, application of adequate electrochemical and modern physical methods of analysis aiming to clarify the mechanisms of the influence of various factors on electrode processes.

The scientific contributions to the overall scientific work of Assoc. Prof. Ivanov could be summarized in the following main areas:

- Polyaniline layers have been synthesized and electrochemically characterized, and their applicability as a substrate for electroless deposition and electrocrystallization of various metals, as well as their electrocatalytic activity after acid doping, has been studied.
- Composite layers with electrocatalytic and photocatalytic activity (TiO₂-PANI, PANI-AuNPs, PANI-Pd NPs, (PANI-PSS)Pd_{electroless}, PANI-PAMPSA, Pt(Cu)/TiO₂/Ti) were obtained by electrodeposition and adsorption methods, and their comprehensive study shows the possibility of their use in electrochemical sensors for the differential determination of biologically important analytes (dopamine, uric acid, ascorbic acid) as well as hydrazine, H₂O₂ and methanol.
- New anode and cathode materials have been developed for energy storage systems using a variety of synthesis methods. Among them, porous materials such as anodic TiO₂NTs with and without Si and nanoporous Si, SnO₂ and TiO₂ nanoparticles, thin electrodeposited Si layers have been synthesized and studied. The materials have been tested for lithium-ion intercalation in conventional electrolyte and in ionic liquids as anode materials for Li-ion. A double Al- and Fe-substituted cathode material with stoichiometry LiNi_{0.6}Mn_{0.2}Co_{0.15}Al_{0.025}Fe_{0.025}O₂ (NMCAF) has been obtained by the “self-combustion” method. A pulsed electrochemical technique has been successfully applied to obtain MO_x-C (M=Sn, Ni) and Pt/MO_x-C hybrid composites with catalytic properties for direct alcohol fuel cells.
- A thorough analysis of the electrochemical and morphological properties of the lithium-electrolyte interface (SEI) for metal Li energy storage systems has been carried out. The influence of some additives (polysulfides and LiNO₃, diphenyl octyl phosphate (DPOP) and vinyl carbonate (VC)) on the properties of the SEI has been established.
- New methods, approaches and research equipment for thermodynamic and electrochemical characterization of energy storage processes and materials are proposed, such as:
 - thin-film calorimeter for studying the thermodynamic properties of active energy storage materials and solid electrolyte.
 - electrochemical *in situ* dilatometry for testing Li-ion electrodes, and an electrochemical-mechanistic model for electrode expansion and accumulation of mechanical stresses and their influence on electrode processes;
 - conductometric transducing in electrocatalytical sensors based on conductive polymers. The method has been tested for the detection of ascorbic acid.
 - application of the Taguchi method and combined *in situ* ZRA (Zero-Resistance-Amperometry)-QCM method in studying corrosion processes in Li-ion and lithium batteries.

Particularly impressive are the publications of Assoc. Prof. Ivanov, distinguished as equivalent to a monography, which present results on electrodeposition of silicon as a binders-free anodic material for Li-ion and Na-ion batteries. The processes of nucleation and growth during electrodepositing silicon from ionic liquids and sulfolane-based electrolytes on various substrates such as glassy carbon, copper, nickel, and porous copper substrates have been studied in detail. It has been proven that the electrodeposition of silicon from the proposed new sulfolane-based electrolyte allows the formation of thin layers with low roughness and high purity. Ni-NiO nanofibers and electrodeposited Si-containing anode binder-free materials have been chemically synthesized and tested with intention of being used as anodic active materials.

The critical analyses of important electrochemical practice methods, processes and technological problems related to energy storage systems presented in the three review articles co-authored by Assoc. Prof. Ivanov could be considered a significant scientific contribution. The overview of charge storage mechanisms combines a developed methodology for identifying and quantitatively distinguishing Faradaic, pseudocapacitive and capacitive charge storage by conventional electrochemical methods. In this regard, the great significance of this work for electrochemical practice is demonstrated by over 120 citations received in the two years since its publication.

3. Reflection of scientific publications of the candidate in Bulgarian and foreign literature

The current research topics of Assoc. Prof. Ivanov, as well as the important contributions to optimizing the design of materials for achieving high-performance Li-ion batteries, are widely reflected in the literature, which can be judged by the significant number of citations. Out of the 1056 citations noted by the candidate, there are 756 (according to SCOPUS) since the beginning of the habilitation of Assoc. Prof. Ivanov.

4. Critical remarks and recommendations to the candidate's scientific works

All of the papers of Assoc. Prof. Ivanov are written in an exceptionally good scientific style, contain elements of critical analysis and innovation, and the presented documents as evidentiary materials are fully in accordance with the requirements of the competition. For these reasons, I have no critical remarks or recommendations for the materials submitted in the competition.

CONCLUSION

The high level of scientific and applied scientific contributions that Assoc. Prof. Ivanov's work achieves, as well as the new methods and techniques developed with his participation for detailed physicochemical characterization of new materials in the field of energy storage and electrocatalytic substances are significant and would contribute to the development of the Institute of Physical Chemistry. The materials submitted for the competition meet all the requirements of the Act on the Development of the Academic Staff in the Republic of Bulgaria, the Regulations for its implementation and the Regulations on the terms and procedures for acquiring scientific degrees and for occupying academic positions at the Institute of Physical Chemistry "Acad. R. Kaishev" at the Bulgarian Academy of Sciences. All of the above gives me full reason to confidently recommend Assoc. Prof. Dr. Svetlozar Dimitrov Ivanov to occupy the academic position of "professor" in the scientific field: 4.2. Chemical Sciences, scientific specialty "Physical Chemistry".

May 19, 2025
Sofia

Scientific jury member:
/Boriana Tzaneva/