

Review

from

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Department of Physical Chemistry

Subject: competition for **associate professor** in professional field 4.2. Chemical Sciences (Solid State Chemistry), State Gazette No. 24 of 17.03. 2023; Order of the Rector of Sofia University "St. Kliment Ohridski" Kliment Ohridski" RD – 38 – 132 / 24. 03. 2023 and decision of FS – FHF, minutes N 17 / 21.03.2023

1. General information about the applicant

In the announced competition for associate professor in professional field 4.2. Chemical Sciences (Solid State Chemistry) for the needs of the Department of Applied Inorganic Chemistry (PNH) at the Sofia University "St. Kliment Ohridski". Kliment Ohridski" participates one candidate, Dr. Lyuben Dimitrov Mihaylov, 42 years old, Chief Assistant Professor in the same Department from 2021.

The candidate has a rich professional and creative biography, graduated from the University of Mining and Geology – Sofia, specialty "Mining Engineering" in 1999 and a master's degree in Materials Science at the Sofia University "St. Kliment Ohridski" in 2009. During his studies he worked as an engineer in the field of extraction and processing of stone facing materials and as an electrical technician. As a student in the Master's degree in Materials Science he began to deal with solid state chemistry, with research in the field of amorphous and nanocrystalline alloys for hydrogen storage at the Department of Applied Inorganic Chemistry, FHF-SU. There is a specialization in Belgium, IMEC, in the field of materials with a low dielectric constant.

Lyuben Mihaylov has a PhD thesis for the scientific and educational degree "Doctor" in 2013 on "Electrocatalytic activity of amorphous and nanocrystalline alloys for hydrogen separation"

headed by Professor Toni Spassov in the professional field is 4.2. Chemical Sciences (Solid State Chemistry), which meets the guidelines of the announced competition.

In the period 2015 – 2021, the candidate works as a Chief Specialist (Chemical Sciences) at the Department of Applied Inorganic Chemistry, FHF-SU. During this period, Dr. Mihaylov specialized in the field of transmission electron microscopy, became an operator and currently a leading scientist at the Laboratory of Electron Microscopy, FHF-SU. Its activities include installation and management of the electron microscope purchased under the Beyond Everest project, mastering the intricacies of electron microscopy with elemental analysis and diffraction, as well as service activities within various projects. This is important for the future development of the candidate because, in parallel with standard research, it manages to delve deeper into the morphology and structure of amorphous and nanocrystalline hydrogen storage alloys and, moreover, to gain a broad view of the morphology of different classes of functional materials.

2. Scientometric indicators. Documentation.

The documents for participation in the competition of the candidate (19 in number) meet the requirements of the Rules of Sofia University "St. Kliment Ohridski" and its scientific and educational profile is in accordance with the requirements for associate professor in the professional field 4.2. Chemical Sciences (Solid State Chemistry). There are some minor inaccuracies in the documentation, but this is normal in the presence of so many documents and files.

The presented reference-declaration shows that the scientific achievements of the applicant exceed the minimum state and intra-university requirements for participation in a competition for the academic position "Associate Professor" in the field of higher education 4.2 Chemical Sciences (Solid State Chemistry).

According to the individual minimum national requirements, Dr. Mihaylov shows the following results:

- A. (doctorate), 50 points, 50 points required
- C. Habilitation work, 110 points, if required 100
- D. Scientific publications outside habilitation work, 285 points, if required 200
- E. Citations /SCOPUS, WoS/, 790 points, at 70 required

G. h-index = 12, projects, new courses, graduates, non-D articles, at least 285 points, with 70 points required.

The applicant has correctly filled in data in the system of Sofia University "St. Kliment Ohridski" THE AUTHORS, as well as full registration in the NACID database as a PhD and Chief Assistant, which is a necessary condition for obtaining the academic position of Associate Professor.

The scientific activity of Dr. Lyuben Mihaylov is related to the training of PhD students and graduates: he is a supervisor or consultant of two theses related to the preparation and properties of nanocrystalline alloys with composition Cu₅₀Ag₅₀ and Zr-Cu-Ni-Al, and some of the publications he has co-authored are an element of successfully defended theses and doctoral theses at Sofia University and BAS.

3. Habilitation work

Dr. Lyuben Mihaylov has presented a habilitation work on the topic: "Obtaining and studying porous metal structures as catalysts in Li ion batteries". We are talking about an interesting written summary in the field of functional inorganic materials. In my opinion, this work deserves the development into a monograph. Research and discussion in the habilitation work are at a high scientific level, everywhere you can see the connection synthesis of alloys – structure (morphology) – properties (catalytic activity). The main results were obtained by modern physical methods: X-ray diffraction, thermal methods, electron microscopy studies, electrochemical studies. The habilitation work is based on the necessary 5 publications (110 points) and presents new scientific facts in an up-to-date scientific field.

4. Publication activity.

The candidate has a high publication activity, clearly visible in the SCOPUS system: L. Mihaylov, 25 publications, about 400 citations, h-index = 12. His publication activity is marked upwards, the same applies to citations that reach 70 / year. The articles are in the field of inorganic materials science with an emphasis on the preparation and selective dissolution of metal alloys, materials for hydrogen storage, microstructure and morphology, nanoparticles. The publications are in prestigious journals in the field of inorganic materials, chemistry and physical chemistry of the solid state (mainly in quartiles Q1 and Q2).

The research has a fundamentally applied nature and potential application in “green” energy: obtaining batteries, hydrogen storage, hydrogen separation and showing capacity for upward development in the future.

In this competition Dr. Mihaylov participates with 17 publications, different from the articles. These are scientific works published in prestigious journals with IF: Corrosion Science, Acta materialia, Intermettallics, Dalton Transactions, RSC Advances and others between 2015 and 2023.

The personal research contributions of the Associate Professor candidate are formulated in the presented document (number 14), they are in the field of inorganic materials science, related to chemical and physicochemical methods for the preparation and characterization of nanocrystalline and amorphous alloys and nanomaterials. The contributions formulated by the candidate are contained in the publications with which he participates in this competition. The more important contributions in these 17 publications are:

1. Preparation and physicochemical characterization of alloys for hydrogen storage, Zr-Cu-Ni-Al, Au-Cu-Ag-Pd-Si, Zr-Ni-Al-Pd, Pd-Ni-Si.
2. Preparation of porous electrodes by electrochemical selective dissolution of alloys and electrocatalytic activity of the materials obtained.
3. New results related to ion battery electrodes. Synthesis and structure of intercalation compounds, $\text{Na}_x\text{Ni}_{0.5}\text{Mn}_{0.5}\text{O}_2$, NaMnPO_4 , Mn_5O_8 .
4. Results related to the structure and morphology of nanosized materials (metal nanoparticles, composites, polymers, hybrid materials, complex oxides, aerogels) obtained using electron microscopy and diffraction, TEM, STEM / EDS.

The role of Dr. Mihaylov in the conducted research is in obtaining various chemical compositions, electrochemical experiments, chemical and thermal analyses, sample preparation, analysis and summarization of the results. The candidate has a leading role in the analysis of nanomaterials using TEM STEM / EDS microscopy, an area in which he belongs to the leading specialists in Bulgaria.

The skillful use of electron microscopy to explain the physical properties of the studied materials is noteworthy: we see structural and chemical characterization of nanophases, finding the shape and dimensions of micro – and nanopores, etc.

The high scientific achievements of Dr. Lyubomir Mihaylov are a consequence of his scientific development. He acquires and develops his research style and skills as a graduate, doctoral student, specialist and lecturer in the group of prof. Tony Spasov, FHF – PNH Department, which has many years of experience and excellent international reputation in the study of amorphous and nanocrystalline alloys for hydrogen storage. This approach is also evident in Dr. Mihaylov's publications, which are in-depth studies in the experimental chemistry of the solid state, leading to new scientific facts in this field.

5. Teaching and project activities

Dr. Lyuben Mihaylov develops a significant project activity, since 2008 he has been a member of the scientific teams of 10 international and national projects of the Faculty of Chemistry and Pharmacy: Beyond Everest, Center of Excellence and others. The teaching activity of the candidate is important both for the Department of Applied Inorganic Chemistry and for the students who from the different bachelor's and master's degree programmes at the Faculty of Chemistry and Pharmacy: Dr. Mihaylov is a lecturer in Applied Electrochemistry, Transmission Electron Microscopy, Processes and Apparatus and Inorganic Chemical Technologies.

6. Personal impressions

I have known Dr. Lyuben Mihaylov since 2009 as an excellent student in the Master's degree in Materials Science, then a PhD student at the PNH Department and today as a respected and competent lecturer at the FHF and one of the leading specialists in electron microscopy in the country. We have no joint posts with the candidate for associate professor. I have witnessed his high professional skills in the field of electron microscopy in conducting joint electron-microscopic studies of metal nanoparticles, silicate and titanium aerogels.

7. Conclusion

In conclusion, I think confidently that Dr. Lyuben Dimitrov Mihaylov meets all the requirements of the Law on the Development of Academic Staff in the Republic of Bulgaria (ZRASRB) and the Regulations on the terms and conditions for acquiring the academic position of Associate Professor at the Faculty of Chemistry and Pharmacy at Sofia University "St. Kliment Ohridski". Kliment Ohridski".

Based on my acquaintance with the presented scientific works and the results in them, which exceed the requirements of the Regulations on the terms and conditions for acquiring the academic position of Associate Professor at the Faculty of Chemistry and Pharmacy at Sofia University "St. Kliment Ohridski". Kliment Ohridski", I recommend Dr. Lyuben Dimitrov Mihaylov to take the academic position of **Associate Professor** in professional field 4.2. Chemical Sciences (Solid State Chemistry).

Sofia, 27.06.2023

Prof. Dr. Stoyan Ivanov Gutzov