

STANDPOINT

by Assoc. Prof. PhD Dimitrinka Aleksieva Nikolova
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on the competition for occupying the academic position an Associate Professor in a professional field 4.2. "Chemical Sciences", scientific research specialty "Solid state chemistry" for the needs of the Institute of General and Inorganic Chemistry at the Bulgarian Academy of Sciences, Laboratory "Electron Spectroscopy of Solid Surfaces"

The competition for "Associate Professor" in the scientific research specialty "Chemical Kinetics and Catalysis" is announced in „Newspaper of State”, issue 46 of 26 May 2023 by the Institute of General and Inorganic Chemistry (IGIC) at the Bulgarian Academy of Sciences (BAS) for the needs of the Laboratory "Electron Spectroscopy of Solid Surfaces". The only candidate in the competition is Assistant Professor PhD Alexander Svetoslavov Tsanev. All the documents, required and specified by the “Regulations for the Conditions and Order of Appointing in Academic Positions” in the Institute of General and Inorganic Chemistry of BAS have been duly submitted. The candidate meets the minimum requirements of BAS for occupying the academic position of "Associate Professor", as well as the increased criteria of the Institute of General and Inorganic Chemistry.

Assist. Prof. Tsanev is co-authored of 29 publications, 20 included in the competition. 8 of which are presented in the **Habilitation work** - 1 of them being of the highest Q1 category, 2 in Q2, and 2 in Q4. The rest of 12 publications are included in non-Habilitation work. Co-author of a published book chapter or collective monograph. Of the total 52 (w/o auto citations), as 38 citations are from the database of Scopus. The h-index from the Scopus database is 5.

The scientific contribution included in the **Habilitation work** of Assist. Prof. Tsanev reveals a clearly delineated research focus for the application of X-ray Photoelectron Spectroscopy (XPS) as an informative approach in the development of new cerium conversion coatings to increase the corrosion resistance of aluminum alloys as a replacement for the toxic hexavalent chromium widely used for corrosion protection. The significance of XPS analysis is in the evaluation of the corrosion characteristics and behavior of the already obtained cerium layers, as well as the condition of the surface of the aluminum alloy. The significance is determined by the wide application of aluminum alloys as structural materials in industry.

The main scientific contributions are expressed in the following directions:

Evaluation of the influence of aluminum alloy surface pretreatment procedures on the formation and properties of the cerium coating and the corrosion behavior of the aluminum alloy

- -In case of alkaline activation by NaOH and combined activation with alkaline treatment followed by acid treatment by HNO₃, it was found that the different pretreatment leads to Al-substrates of different thickness and composition, which affects the qualities of the applied protective cerium layers. It was also established that the thickness of the cerium conversion layers is significantly influenced by the presence of Ce³⁺ ions, and the presence of slightly soluble Ce⁴⁺ ions is

decisive for increasing the resistance of the coating, thus ensuring the maximum protection of aluminum alloys.

- When combining anodizing in aqueous solutions of orthophosphoric acid with successive processing in a solution of CeCl_3 of the aluminum layers, it was established that the higher corrosion resistance of the obtained cerium coating was obtained.
- When anodic polarization is applied to a potential close to the pitting potential, the applied cerium layer is practically not affected by the corrosive effect of the aggressive environment and mainly only an increase in the amount of corrosion products from AlOOH and $\text{Al}(\text{OH})_3$, whose low solubility increases the corrosion of the stability of the $\text{Al}/\text{Al}_2\text{O}_3/\text{Ce}_2\text{O}_3$ system.

Evaluation of the influence of the role of additional ion introduction, such as phosphates and silver, in enhancing the corrosion resistance of aluminum alloys

- During the deposition of phosphate coatings on ceria conversion layers, the resistance is affected by the formation of stable compounds between aluminum and phosphorus, and between ceria and phosphorus (AlPO_4 and AlOOH , CePO_4), as well as stable phosphorus oxides (P_2O_5 and P_4O_{10}).
- When silver is introduced into the pores of aluminum alloys in the form of Ag^+ , corrosion resistance is also increased.

The other publications presented by the Assist. Prof. Dr. Tsanev outside *the Habilitation work* are also related to the application of the X-ray photoelectron spectroscopy method for the analysis of the surface qualities of catalysts, oxides and electrolytes. The publications are organized in three directions:

1. Study by XPS of electrochemical corrosion and processes taking place in electrolytes.
2. Investigation by XPS of processes of catalysis, photocatalysis and electrocatalysis.
3. Identification and proof by XPS of oxide phases resulting from chemical synthesis.

The publications outside *the Habilitation work* definitely show that Dr. Tsanev has experience in a wide scientific field.

The relevance among the scientific community of the works presented in the competition is indisputable proof of the scientific activity of Assist. Prof. Tsanev. Without a doubt, Dr. Tsanev is a researcher with abilities in the field of application of X-ray photoelectron spectroscopy as a mandatory element for evaluating the surface structure and determining the surface interactions between components, as an indispensable part of the approach of developing catalysts and corrosion coatings of alloys. The importance of XPS spectroscopy is determined by the wide application of the method for the study and development of nano-structures on the surface of materials with application in both catalytic and corrosion processes. Information from

this spectral method provides information and guidance to researchers on how to improve the properties and/or protect a given material or catalyst.

After reviewing the presented materials and based on personal impressions of working together, **I confidently suggest** of the members of the Jury and to the Scientific Council of IGIC-BAS to vote positively and to approve Assistant Professor PhD Alexander Svetoslavov Tsanev for occupying the academic position of “*Associate Professor*” in the professional field 4.2. "Chemical Sciences", scientific research specialty "Solid state chemistry" for the needs of the Institute of General and Inorganic Chemistry at the Bulgarian Academy of Sciences, Laboratory "*Electron Spectroscopy of Solid Surfaces*".

Date 14. 09. 2023

Member of the Scientific Jury:

/Assoc. Prof. Dr. Dimitrinka Nikolova /