

OPINION

by Assoc. Prof. Stela Ivanova Minkovska-Dodova, PhD, Institute of Catalysis-BAS
on the competition for occupation of the academic position **“professor”**
in professional field **4.2 Chemical Sciences**,
Scientific specialty **“Chemical Kinetics and Catalysis”**.

In the competition for the academic position of "professor", announced in the State Gazette, issue 82 of 07.10.2025 and on the website of the Institute of Catalysis-BAS only one candidate is participating - Assoc. Prof. Dimitrinka Aleksieva Nikolova, PhD.

1. General presentation of the procedure and the candidate.

Assoc. Prof. Dimitrinka Aleksieva Nikolova, PhD graduated from the University of Chemical Technology and Metallurgy - Sofia as a Master of Science in Chemical Engineering in 1995, earning the educational and professional degree in Chemical Engineering in specialty “Inorganic and Electrochemical Technologies”. In 2005, she defended her PhD thesis entitled “Effect of Potassium Addition on the Activity and Structure of NiO–MoO₃–Al₂O₃ Catalysts for the Water–Gas Shift Reaction in the Presence of Hydrogen Sulfide” at the Institute of Catalysis, Bulgarian Academy of Sciences. Her research career began in 1996 at the Institute of Catalysis, Bulgarian Academy of Sciences, where she successively held the positions of Research Chemist (1996–2007) and Assistant Professor (2007–2016). In 2016, she was elected Associate Professor in the Laboratory of Catalysis for Energy and Environmental Protection. Since 2024, Assoc. Prof. Nikolova has served as Chair of the Bulgarian Catalysis Society, having previously been its Vice-Chair (2019–2023). She has also held the positions of Secretary of the Scientists’ Colloquium at the Institute of Catalysis and Secretary of the Scientific Council of the Institute of Catalysis, BAS.

Assoc. Prof. Nikolova’s scientific and applied research interests are focused on the design and investigation of nanoscale metallic and metal-oxide catalysts as a foundation for developing innovative technologies in sustainable energy and green chemistry. Her primary emphasis is on catalytic processes for hydrogen production and purification, including the water–gas shift reaction in the presence of sour (sulfur-containing) gases and the conventional water–gas shift process. Her research also encompasses heterogeneous catalytic reactions such as methanation and the partial hydrogenation of vegetable oils. Part of her scientific activity is directed toward electrocatalysis, including the development of anodic catalysts for alkaline fuel cells, cathodic catalysts for the electrochemical synthesis of green ammonia, and catalysts for electrolytic hydrogen production.

2. General characteristics of the candidate's research and applied scientific activity.

Assoc. Prof. Nikolova participates in the competition with 21 scientific publications in peer-reviewed and indexed journals, 1 book chapter, 2 patents, and 1 patent application. In the submitted habilitation work, which summarizes the results of 9 publications (5- Q1, 1- Q2, 1- Q3, and 2-Q4), Assoc. Prof. Nikolova demonstrates a substantial personal contribution to the conducted research and the interpretation of the results; she is first author on four publications and corresponding author on six. The obtained results have been presented at 68 scientific forums, including one plenary lecture at an international conference, one plenary lecture at a national conference, 12 oral presentations at international forums, 10 oral presentations at national forums, three seminar presentations, and 41 poster presentations.

Assoc. Prof. Nikolova has served as principal investigator of three projects under the Inter-Academic Cooperation Program (EBC): two in collaboration with the University of Belgrade, Serbia, and one with the National Research Centre in Giza, Egypt. She has also led two projects with the Israeli company GenCell Ltd. and acted as coordinator for the Institute of Catalysis, BAS, within the “Center of Competence HITMOBIL” Currently, she is the principal investigator of a project funded under the National Recovery and Resilience Plan entitled “Clean Hydrogen Technology for Green Energy – A Step Towards Zero Emissions.”

Assoc. Prof. Nikolova has been a team member in two projects funded by the National Science Fund of the Ministry of Education and Science, and a participant in five projects under the Inter-Academic Cooperation Program (EBC), including collaborations with the Institute of Physical Chemistry of the Romanian Academy, Ghent University (Belgium), and the University of Belgrade (Serbia). She has also participated in the National Scientific Program “Low-Carbon Energy for Transport and Households” (EPLUS), funded by the Ministry of Education and Science. For eleven years, she contributed to the project “Development of Non-Precious Metal Catalysts for Alkaline Fuel Cell Products of GenCell,” funded by GenCell Ltd.

Assoc. Prof. Nikolova has supervised two undergraduate students who successfully completed their Bachelor’s degree theses at the University of Chemical Technology and Metallurgy (UCTM), Sofia. She is also engaged in expert academic service, preparing reviews and evaluation reports for procedures related to educational qualifications, academic degrees, and academic positions.

3. Evaluation of the submitted materials.

The materials submitted by Assoc. Prof. Nikolova for the competition are organized according to the evaluation indicators as follows:

Indicator A: PhD degree thesis– **50** points (minimum required: 50 points).

Indicator B: **9** publications in journals indexed with an ISI Impact Factor and/or SJR, distributed by quartiles as follows: **5** in Q1, **1** in Q2, **1** in Q3, and **2** in Q4.

Total points under Indicator B: **184** points (minimum required: 100 points).

Indicator C: **12** publications in journals indexed with an ISI Impact Factor and/or SJR, distributed by quartiles as follows: **5** in Q1, **2** in Q2, **1** in Q3, and **4** in Q4; **1** book chapter published by an international academic publisher (15 points); **2** patents supported by issued protection documents (**50** points); and **1** published patent application.

Total points under Indicator C: 308 points (minimum required: 220 points).

Indicator D: Citations in scientific publications indexed in internationally recognized databases (Web of Science and Scopus) – a total of 217 citations.

Total points under Indicator D: **434** points (minimum required: 120 points).

Indicator E: Participation in national research projects – **8** projects (80 points);

Participation in international research or educational projects – **2** projects (40 points);

Leadership of national research or educational projects – **3** projects (60 points);

Leadership of a Bulgarian team in international research or educational projects – **5** projects (250 points);

Total funds attracted through projects led by the candidate – **209.63** points.

Total points under Indicator E: **639.63** points (minimum required: 150 points).

3. Basic scientific and scientific-applied contributions

The scientific results achieved by Assoc. Prof. Nikolova are directly related to the development of green energy technologies, specifically in the production of clean hydrogen through catalytic processes. They contribute to the improvement of environmental quality and the reduction of pollution, which has a positive impact on public health, as outlined in Priority 2 of the National Strategy for the Development of Scientific Research in the Republic of Bulgaria 2017–2030.

Fundamental Contributions

Development and study of rhenium-containing catalysts for clean hydrogen production via CO conversion with water vapor:

1. Established the role of rhenium as an electronic promoter in CoRe catalysts, enhancing the formation and stabilization of active sites, activation of reactant molecules, and water dissociation.
2. Demonstrated the critical importance of the optimal redox balance between $\text{Re}^{4+}/\text{Re}^{7+}$ and $\text{Co}^{2+}/\text{Co}^{3+}$ for catalytic activity, reaction mechanism, and the relationship between electron transfer in the Re–Co system and surface reactivity.

3. Clarified the effect of alkali modification on redox transformations in CoRe-based systems, showing that predominant formation of reduced Re^{4+} and Co^{2+} decreases catalytic activity, whereas in multicomponent systems with Mo, $\text{Mo}^{4+}/\text{Mo}^{6+}$ redox interactions alter potassium's effect.
4. Demonstrated that rhenium can effectively replace noble metals (Au) in low-temperature water–gas shift (WGS) catalysts, highlighting the influence of the $\text{Re}^{4+}/\text{Re}^{7+}$ redox pair on activity.
5. Shown that the presence of CeO_2 modifies structural features and increases the $\text{Re}^{4+}\text{--O}/\text{Re}^{7+}\text{--O}$ ratio, a key factor for catalyst stability and activity at high CO concentrations.
6. Established that the ratio of rhenium sulfide to oxide forms ($\text{Re}^{4+}/(\text{Re}^{7+}+\text{Re}^{6+})$) is critical for redox interactions and determines catalytic performance in low-temperature WGS under sulfur-containing gas mixtures.
7. Demonstrated that the combined presence of K, Co, and Re in trimetallic KCoRe catalysts provides an optimal $\text{ReS}_2/\text{ReOxSy}$ balance, leading to component synergy and enhanced stability at low temperatures.
8. Shown that uniform dispersion of active components on the support and enrichment of Co–S species at the surface improve reactant accessibility and catalyst dispersion, significantly enhancing activity.
9. Demonstrated that introducing Co, Ni, and K in trimetallic Mo, W, Re catalysts induces synergy, maintaining stable ratios between sulfide and oxysulfide species, which is essential for high catalytic activity.
10. Established that the catalytic activity of “acidic” trimetallic catalysts is governed by the metal–sulfur bond strength, which is controlled by composition and the presence of alkali and transition metals, affecting the stability of active sites under oxidizing conditions.

Development and study of non-noble electrocatalysts for green energy generation via hydrogen fuel cells and green hydrogen production:

1. Established that wet chemical reduction of Ni/BCY15 in ethylene glycol produces smaller, well-dispersed Ni^0 particles (9.1 nm), preserves the ceramic matrix structure, and ensures H_2 accessibility to active sites.
2. Demonstrated that $\text{Ni}^0\text{--Ce}^{3+}$ interactions stabilize metal particles, reduce Ni migration and agglomeration, and promote autoredox reduction of NiO, providing structural stability and slow degradation of the anode.
3. Shown that residual metallic Ni^0 remains stable under extreme thermal conditions (1100 °C) and forms active centers for dissociative hydrogen adsorption, significantly enhancing anode electronic conductivity.
4. Established that co-electrodeposition of Ni and Co with phosphorus (NiCoP) generates unique 3D morphologies, surface enrichment in $\text{Ni}^0/\text{Ni}^{2+}$, and a thinner surface oxide layer, increasing active site accessibility, facilitating H_2 and O_2 transport, and enhancing bifunctional HER and OER activity.
5. Clarified the structure–function relationship between morphology, chemical composition, and electronic structure of NiCoP coatings, determining their high catalytic activity and stability.

Applied Scientific Contributions.

1. High catalytic activity and stability of the CoRe catalyst under elevated operational load have been demonstrated, indicating its potential for practical applications in clean hydrogen production processes.
2. Regulation of the $\text{Re}^{4+}/\text{Re}^{7+}$ redox balance and catalyst composition enables targeted enhancement of activity and durability under various reaction conditions, which is essential for practical applications as noble metal substitutes.

3. The developed KCoRe catalyst is sulfur-resistant and suitable for industrial application for single-stage KVOHP purification of gas mixtures, providing both high activity and additional hydrogen production.
4. It has been established that the Ni/BCY15-EG anode provides higher structural and electrochemical stability under repeated redox cycles, which guarantees long-term stability of the electrodes and reliability of the fuel cell during operation.
5. The efficiency of synthesis by wet chemical reduction with hydrazine in ethylene glycol is demonstrated as an energy-efficient method for producing Ni/BCY15 anode with high activity, stability and resistance to degradation.
6. The developed co-electrodeposition approach is scalable and applicable for the production of sustainable catalysts for green energy via hydrogen electrolysis, with potential for future optimization.

5. Reflection of the candidate's scientific publications in the Bulgarian and foreign literature.

To December 2025, the works of Assoc. Prof. Nikolova have been cited 217 times (Indicator D), exceeding the requirements for this indicator according to the Regulations of the Institute of Catalysis for appointment to the academic position of “Professor.” The Hirsch index (h-index) of Assoc. Prof. Nikolova, based on all publications, is 10 (Scopus).

6. Critical Remarks and Recommendations

I have no critical remarks regarding the candidate. The submitted documents for the competition are properly prepared according to the requirements and contain comprehensive information on the candidate’s achieved results and scientific contributions.

5. CONCLUSION

The publications submitted by the candidate are fully aligned with the topic of the competition and represent original scientific and applied research, making a significant contribution to the design and investigation of nanoscale metallic and metal-oxide catalysts as a basis for the development of innovative technologies in sustainable energy and green chemistry.

In light of the above, I consider that the materials presented by Assoc. Prof. Dr. Dimitrinka Alexieva Nikolova fully comply with the Law on the Development of the Academic Staff in the Republic of Bulgaria, its implementing regulations, as well as the Rules for the Conditions and Procedures for Appointment to Academic Positions at the Institute of Catalysis – BAS. I confidently give my positive evaluation and strongly recommend to the esteemed Scientific Jury and the Scientific Council of the Institute of Catalysis-BAS that the academic title of “**professor**” be conferred upon **Assoc. Prof. Dimitrinka Alexieva Nikolova, PhD** in the professional field 4.2. Chemical Sciences, scientific specialty “Kinetics and Catalysis,” for the needs of the Laboratory “Catalysis for Energy and Environmental Protection.”

February 5, 2026

Reviewer:

/Assoc. Prof. Stela Minkovska-Dodova, PhD/