

REVIEW

by Assoc. Prof. Dr. Ivanka Petrova Spasova, IONH-BAS

on the materials submitted for participation in the competition

for the academic position of "Associate Professor" in the Laboratory "Materials and Processes for Environmental Protection" of IGIC- BAS

Professional field 4.2 Chemical sciences (Chemical kinetics and catalysis)

In the competition for the academic position of "Associate Professor", announced in the State Gazette, issue 47 of 4.06. 2021, for the needs of the laboratory "Materials and processes for environmental protection", the only candidate is Chief Assistant Dr. Daniela Dimitrova Stoyanova. The submitted materials for participation in the competition are in accordance with the Regulations on the terms and conditions for acquiring scientific degrees and for holding academic positions at IGIC- BAS and include all necessary documents.

1. Brief biographical data about the candidate

Chief Assistant Dr. Daniela Dimitrova Stoyanova graduated in 1993 from the University of Chemical Technology and Metallurgy - Sofia, majoring in "Inorganic and Electrochemical Production" with a Thesis on "Cordierite carriers of catalysts". In 1996 she has started work at IGIC-BAS as a chemist. In 2002 she defended her PhD Thesis on the topic: "Copper-cobalt oxide catalysts supported on La-modified aluminosilicate composites and γ -Al₂O₃ for waste gas purification", and since 2004 she has been a Chief Assistant at IGIC- BAS, laboratory "Materials and processes for environmental protection".

2. Description of the submitted materials

Chief Assistant Dr. Daniela Stoyanova is a co-author of a total of 38 scientific papers, 5 of which are included in her dissertation. She has applied for participation in the competition with 26 scientific papers and 1 patent, all after the doctoral dissertation. The distribution of scientific papers for participation in the competition by the respective quartiles is as follows: Q1- 5 publications (in the journals Chemical Engineering Journal, Catalysis Communications, Nano-Structures and Nano-Objects, Materials

Characterization), Q2- 7 publications (in the journals Journal of Porous Materials, Journal of Chemical Technology and Metallurgy, Comptes rendus de l'Académie bulgare des Sciences, Journal of rare earths, Coatings), Q3- 6 publications, Q4- 8 publications. Dr. Stoyanova is the first author in 10 of the presented publications, and in 4 she is the second author.

The publications for the competition are divided into two groups, covering indicators B and G, according to the Regulations on the terms and conditions for obtaining scientific degrees and for holding academic positions. In the first group, indicator B - Habilitation work – all 10 scientific publications are referenced and indexed in world databases with scientific information (WoS or Scopus), divided into quartiles as follows: Q1- 2, Q2- 2, Q3- 3, Q4- 3, and the total number of points is 171, with a required minimum of 100 points.

The second group presents 16 publications and one patent (3-Q1, 5-Q2, 3-Q3, 5-Q4), covering indicator G, with a total of 305 points with the required 220 points. In the group of indicators E, the requirements are also significantly exceeded - with the required 60 points, the candidate has 280 points.

154 citations were noted on all articles, 140 from the Scopus database and 14 from other sources. The citations of the publications for participation in the competition are 103 (Scopus). The Hirsch index of Dr. Daniela Stoyanova according to data from Scopus is 5, which covers the minimum additional requirements of IGIC- BAS for h-index.

The candidate also exceeds the additional requirements, according to the Regulations for the terms and conditions for acquiring scientific degrees and holding academic positions in IGIC- BAS, having achieved 90 tons with the required 70 tons in the additional indicator J.

Dr. Daniela Stoyanova has attached a list of 27 reports from the participation in national and international scientific forums.

Chief Assistant Dr. Daniela Stoyanova was a member of the team of 4 nationally funded projects (National Science Fund) and a leader of 4 projects with the Republic of Serbia. She participated in the competition with 4 projects funded by the NSF.

All submitted materials are on the topic of the competition. The scientometric indicators exceed the minimum national, also specific of BAS requirements for the individual indicators in the ZRASRB and the Regulations for its application for the academic position "Associate Professor" in the field of "Natural Sciences, Mathematics and Informatics", professional field 4.2 "Chemical Sciences". Dr. Stoyanova has achieved 896 points with the required 500 points.

3. General characteristics of the research activity

The research activity of the candidate can be related to the application of catalysis in environmental protection processes and corresponds to the topic of the competition for the needs of the lab. "Materials and processes for environmental protection". The research is focused on the design of supports and catalysts for the purification of waste gases from vehicles and energy. The main attention is paid to the synthesis of oxide and composite supports, with the aim of finding universality in the composition of the supports, which after appropriate processing can be used to obtain catalysts operating in different reaction media. Part of the research is aimed at obtaining and studying supported catalysts containing precious metals and transition metal oxides with a view to their practical application for waste gas purification in processes of NO reduction with CO, CO oxidation and complete oxidation of hydrocarbons.

4. Major scientific contributions

The candidate's contributions presented in the habilitation report are on the synthesis of catalyst supports based on multicomponent oxide systems with suitable mechanical, morphological and thermal properties and on the preparation and research of supported metal oxide catalysts with high activity and selectivity, high thermal resistance and increased resistance to catalytic poisoning.

A composition of a mulite-cordierite ceramic support with good thermal properties and a synthetic approach for preparation by processing at lower temperatures compared to classical ceramics has been found. It was found that modification of $\gamma\text{-Al}_2\text{O}_3$ with up to 3 wt. % La prevents the "sinking" of Cu and Co ions (depending on the selective adsorption) in the bulk of the support $\gamma\text{-Al}_2\text{O}_3$ in the preparation of the supported catalysts, as a result of which the catalytic active centers for reduction of NO with CO and for oxidation of CO and benzene are increased.

The possibility of utilization of deactivated Pd-containing corundum catalysts by modification with NiO and their use in the reduction of NO with CO at temperatures below 200°C is also shown. The utilization of metallurgical slag has led to the creation of a catalyst for CO oxidation and complete oxidation of toluene. For copper-cobalt catalysts supported on a high-temperature commercial ceramic support (containing Al₂O₃, SiO₂, MgO), the phase formation temperature was found to be decisive for the catalytic activity and for the resistance of the catalysts to SO₂ poisoning during CO oxidation.

It has been found that the storage-reduction catalyst Ag (BaCO₃)/Al₂O₃ for NO_x is more resistant to catalytic poison SO₂, despite its lower efficiency than the classical catalysts for purification of waste gases from internal combustion engines based on precious metals. A reaction mechanism has been proposed which involves the oxidation of adsorbed nitrogen oxides to surface nitrates.

It has been found that the impregnating medium (aqueous or organic) has a stronger effect on the dispersion of the active phase and less on the oxidation state of the iron ions in the active phase in catalysts containing Fe and supported on activated carbon. An order of activity of the catalysts obtained in different precursor media with respect to the reduction of NO with CO was found.

Mechanochemically prepared perovskite-type catalysts (LaT_xMg_yFe_zO₃) in the NO decomposition reaction were studied. It was found that direct decomposition takes place at temperatures above 250°C, and the efficiency of the catalyst is related by the presence and participation of Fe³⁺ ions in the active centers.

The optimal conditions for the synthesis of dispersed Cu-Zn-Al spinel-like catalysts by co-precipitation have been established. The catalysts were tested for the decomposition of N₂O to N₂ in a real gaseous medium from an industrial plant for production of HNO₃ by the Oswald method. A highly efficient catalyst for the decomposition of the by-product N₂O in the first stage of the catalytic oxidation of NH₃ has been found.

The contributions in the habilitation part can be classified as a novelty in science and enrichment of the existing knowledge, with a pronounced potential for industrial application. The obtained results of the research have both scientific and applied

significance and are a contribution in the field of synthesis of catalysts with predetermined characteristics.

The author's reference for the works of Chief Assistant Dr. Daniela a Stoyanova, outside the habilitation part, is based on 16 scientific publications. They have a broader focus and cover the design and research of catalysts for methane combustion, CO oxidation, photocatalytic degradation of textile dyes and the production of corrosion-resistant oxide coatings by chemical methods. The main contributions of the candidate in this part are related to the synthesis of nanoscale materials and their physicochemical characterization. The candidate demonstrates skills and experience in obtaining a large set of massive, composite and supported materials by applying a variety of approaches - sol-gel method, mechanochemical production, co-precipitation, hydrothermal synthesis, impregnation and more. By studying the composition-structure-property relationship, dependences between the catalytic activity and the state of the applied active components, the influence of the type of support and the method of catalyst preparation, interaction between the active phases, between the active phase and the support, distribution of the active phase on the surface of the support, factors determining the dispersion of the active components, etc. are found.

5. Critical remarks and recommendations

I have no principle critical remarks.

6. Assessment of the personal contribution of the candidate and personal impressions

The publications, with which Chief Assistant Dr. Daniela a Stoyanova participates in this competition, are collective work. This is determined by the use of a large set of complementary methods and analyzes, as in much of the scientific papers in the field of chemical sciences. The average number of co-authors of the 10 works included in the habilitation work is 4.4, as the candidate is the first author in 7 publications, in 1 publication she is second. This is proof that the candidate is in the basis of the design of the experiment, the implementation and interpretation of the results of research in this part. The more diverse research activity outside the habilitation section has added more co-authors.

I have witnessed the development of Dr. Stoyanova as a researcher since her admission to IGIC-BAS, and over the years she has established herself as a specialist in

the field of synthesis of inorganic materials. Dr. Stoyanova makes an impression of a motivated and able-bodied scientist, which is the basis of her effective research work.

CONCLUSION

The documents and materials submitted by Chief Assistant Dr. Daniela Dimitrova Stoyanova **meet all the requirements** of the Law for the Development of the Academic Staff in the Republic of Bulgaria (ZRASRB), the Regulations for Implementation of ZRASRB, the Regulations for Implementation of ZRASRB of BAS and the Regulations of IGIC-BAS. The candidate in the competition has submitted a sufficient number of scientific papers published after the materials used in her doctoral Thesis. After analyzing the materials presented in the competition, their significance and the scientific and applied contributions contained in them, I find it reasonable to give my **positive** assessment and to recommend to the Scientific Jury to propose to the Scientific Council of IGIC-BAS to elect Chief Assistant Dr. Daniela Dimitrova Stoyanova for the academic position of 'Associate Professor' at IGIC- BAS in the professional field 4.2 Chemical Sciences (Chemical Kinetics and Catalysis).

September 23, 2021.

Reviewer:

(Assoc. Prof. Dr. Ivanka Spassova)