STANDPOINT
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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 "Chemical kinetics and catalysis" for the needs of the Institute of General and Inorganic Chemistry at the Bulgarian Academy of Sciences, Laboratory " Materials and processes in environmental protection "

The competition for "Associate Professor" in the scientific research specialty "Chemical Kinetics and Catalysis" is announced in „Newspaper of State", issue 47 of 4 June 2021 by the Institute of General and Inorganic Chemistry (IGIC) at the Bulgarian Academy of Sciences (BAS) for the needs of the Laboratory "Materials and processes in environmental protection". The only candidate in the competition is Assistant Professor PhD Daniela Dimitrova Stoyanova. 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. Stoyanova is co-authored of 38 publications, 26 of which she participates in the competition, 2 of them being of the highest Q1 category, 2 in Q2, 3 in Q3 and 3 in Q4. There is also one patent. The leading role and significant personal contribution of Assist. Prof. Stoyanova in the researches and summarizing the results is evident from the fact that she is referred to as the first author in 7 publications included in the habilitation work [1-10] and in 5 of them she is corresponding author [5,6,8,9,10]. The rest of 16 publications [11-26] are included in out-of-habilitation work. Of the total 154 citations (w/o auto citations), as 140 are from the database of Scopus. The h-index from the Scopus database is 5.The results from these studies, performed with the participation Assist. Prof. Stoyanova, have been presented at 12 international scientific forums as well as 15 national forums.

The scientific contribution included in the ***Habilitation work*** of Assist. Prof. Stoyanova reveals a clear focus of the researches to improve the properties of catalysts used in highly important field, concerning improving the quality of the atmospheric air by eliminating harmful NO_x and CO emissions in ambient air. There are **two directions**: "Synthesis of polyoxide composites based on alumina, natural minerals (bentonite and clay) and MgO, to obtain carriers with appropriate mechanophysical and physicochemical parameters used for the application of active components and applied in a wide range of catalysts"; and "Development and testing of supported catalysts with a metal oxide active phase content with high catalytic activity and applicability in the processes of purification of gaseous fluids in the chemical, energy and motor transport industries."

The essence of scientific contributions in **the first topic** is consisted in the study of the in the synthesis of catalyst supports with increased thermal stability, mechanical strength and improved texture parameters with application for high temperature catalysts devising. It has been found that a mulitocordierite-like phase can be obtained at a temperature lower by 300 °C (1150 °C) compared to classical ceramics (1450 °C) by applying precipitation as a method of synthesis and the introduction of bentonite or clay additives as well as the presence of MgO. An approach for utilization of a deactivated palladium catalyst for recycling and renewal of the Al_2O_3 carrier by adding bentonite and using this carrier to obtain a Cu-Co catalyst for reduction of NO with CO and oxidation of CO to CO_2 is also proposed. It has also been found that modifying Al_2O_3 with lanthanum increases the activity of the Cu-Co catalyst by preventing the interaction of the applied Cu and Co with the carrier to form aluminates and as a result La doping contributes to increasing the dispersion of the active Cu-Co oxide phase.

The scientific contributions in **the second topic** are related to the development of various catalyst compositions for purification of waste gases from industry and transport containing NO_x and CO.

Part of the research is on catalysts **for the NO reduction reaction with CO**. It is found that the addition of very small amounts of Pd (up to 0.3%) is proper for increase the activity of $CuCo/Al_2O_3$ and Ni/Al_2O_3. The addition of Pd makes the $CuCo/Al_2O_3$ system resistant to poisoning by the presence of SO_2 in the reaction mixture. An Ag-containing catalyst has been proposed as a suitable cheaper catalyst for NO purification due to its higher resistance to SO_2 poisoning compared to Pt-containing. The Fe-oxide phase deposited on activated carbon is another system that has been found as a suitable catalyst, as the determining factor for the dispersion of Fe-oxides is the use of an aqueous solution in the impregnation, not organic solutions.

For the NO decomposition in the absence of a CO reducer, a perovskite type catalyst $LaTi_xMg_yFe_zO_3$ with different content of Mg, Fe and Ti is studied, and it is found that Fe^{3+} ions play a major role in the high activity of perovskite systems.

The oxide CuCo system, calcined at lower spinel-forming temperatures of 350–550 °C, has been established as an active catalyst **for CO oxidation with oxygen**, which is also resistant to the presence of SO_2.

For the reaction of complete oxidation of CO and hydrocarbons, acid and thermally activated metallurgical slag were studied, and it is established that such a new catalyst exhibits very high activity and resistance to SO_2 poisoning.

The next scientific contributions are related to **the decomposition of N_2O, contained in waste gases in the production of HNO_3, to N_2 and O_2**, where the spinel-like structure of copper, zinc and alumina in the ratio Cu:Zn:Al = 1:1:4 has been proposed as a highly active and appropriate catalyst for this reaction.

As an approach that makes an impression in the design of the catalysts is the utilization of industrial waste products and spent catalysts. Another approach that stands out in evaluating the activity of the studied systems is the application of high space velocities in the range of

20,000 h^{-1}–100,000 h^{-1}, as well as the appreciation of resistance to SO_2 poisoning, which makes the investigated catalysts promising for industrial application and outlines the contributions of Assist. Prof. Stoyanova in this catalytic field.

Other publications presented by Dr. Stoyanova ***outside Habilitation work*** are organized in four thematic directions:

1. Synthesis and research of new catalyst composites for combustion of CH_4 on the basis of classical technological schemes for applied type of catalysts: Pd-MeO_x/Al_2O_3 (Me = Co, La, Ce), as it is found that the modification of Al_2O_3 with La and Ce allows the exclusion of toxic Co from the palladium catalyst;

2. Synthesis and research of catalysts of both applied type and obtained by mechanical activation of precursors for the CO oxidation reaction: CuO and NiO with Al_2O_3 support are investigated;

3. Synthesis and characterization of photocatalytic oxide materials in the form of nanosized powders and measurement of their photocatalytic activity for decomposition of model textile dyes and oxidation of ethylene in gas phase and acetylsalicylic acid: nanosized ZnO powders; TiO_2 donated with P; calcium titanate, $CaTiO_3$, with perovskite and zinc orthostanate, Zn_2SnO_4, with spinel structures are proposed;

4. Obtaining a new type of corrosion-resistant one- and poly-component oxide coatings, by chemical methods on different types of metal substrates: sol-gel coatings based on ZrO_2 and TiO_2 are made;

These investigations definitely show that Assist. Prof. Stoyanova has experience in a wide scientific field.

The actuality among the scientific community of the works presented in the competition is an undoubtedly proof of the scientific work of Dr. Stoyanova. Assuredly, she is a researcher with abilities in the field of developing catalysts for the removal of harmful emissions in the environment.

After reviewing the presented materials and based on personal impressions, I suggest with conviction of the members of the Jury and to the Scientific Council of IGIC-BAS to vote positively and to approve Assistant Professor PhD Daniela Dimitrova Stoyanova for occupying the academic position of “Associate Professor” in the professional field 4.2. "Chemical Sciences", scientific research specialty "Chemical kinetics and catalysis" for the needs of the Institute of General and Inorganic Chemistry at the Bulgarian Academy of Sciences, Laboratory "Materials and processes in environmental protection", Institute of General and Inorganic Chemistry at the Bulgarian Academy of Sciences.

Date 23. 09. 2021

Member of the Scientific Jury:
/Assoc. Prof. Dr. Dimitrinka Nikolova /