OPINION

on the Doctoral Thesis of Prof. Dr. Yuri Angelov Kalvachev (Institute of Catalysis - Bulgarian Academy of Sciences) for awarding the scientific degree "Doctor of Sciences"
in Professional field 4.2. Chemical sciences,
Scientific specialty: Chemical kinetics and catalysis
on the topic: "Synthesis and properties of zeolite catalysts"

from Prof. Dr. Hristiyan Aleksandrov Aleksandrov
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The dissertation is written on 146 pages and contains 73 figures, 15 tables, while the cited references are 289. It presents various techniques for synthesis and modification of a number of zeolites and mesoporous materials (LTA, beta, mordenite, ZSM-5, MCM-41, X and L) with industrial application, and also studies their catalytic and sorption properties. At the beginning, an introduction is presented, in which the experimental research is motivated and the main goals set in the dissertation are clearly formulated. The introductory presentation of zeolites continues in the next chapter, in which the main parameters determining their catalytic properties are discussed. The results of the dissertation are presented in five separate parts (chapters 3 to 7). Chapter 3 is devoted to the synthesis and catalytic properties of nanosized zeolites and hierarchical structures. I find very interesting the proposed method of vapor phase transformation of the initial gels for synthesis of LTA type zeolite, which allows preparing samples with more than one order of magnitude smaller crystal particles compared to conventional hydrothermal conditions. The method also allows for precise control of the particle size by varying the synthesis temperature. Similar particle size control was achieved in the synthesis of mordenite, varying different parameters during the reaction (water content in the initial gel, temperature, amount of added seeds). It has been found that the treatment of both mordenite and (Al or Ga)-ZSM-5 zeolites with HF/NH_4F buffer improves their catalytic activity due to the formation of secondary micro- and meso- porosity. Chapter 4 presents the synthesis of Ti-MCM-41 samples containing gold deposited in them. Their catalytic properties in propene, propane and isobutane oxidation were also studied, and a synergistic effect between Au and Ti was found. Chapter 5 is devoted to the synthesis and catalytic

properties of zeolites modified by impregnation with ZrO_2. It was found that the presence of Zr increases not only the activity and selectivity of the catalysts, but also their stability, and at the same time reduces the time for their deactivation. Chapter 6 develops a very interesting idea for the storage and disposal of waste products from coal-fired TPPs. A method for the synthesis of zeolite X from coal ash has been proposed and subsequently the adsorption capacity of the obtained samples with respect to CO_2 has been studied. In this way, the problems of ash deposition as well as CO_2 emissions can be solved. Chapter 7 is devoted to the synthesis and properties of zeolite-polymer hybrid materials. A biocompatible material containing Ag^+ ions with low toxicity and antibacterial properties and a material for controlled drug (enalapril maleate) release have been developed on the base of zeolite L.

The presented abstract is carefully prepared and fully reflects the results from the performed experimental studies. In the dissertation are included 27 scientific publications, 18 of which are in peer-reviewed and indexed journals, and three are patents. Most of these articles (9) are published in journals from the first quartile (Q1), five articles are in journals from Q2, two are in Q3 and two are in Q4. Some of these journals are among the most respected ones in the field of catalysis (*Journal of Catalysis, Applied Catalysis B: Environmental, Catalysis Communication, Catalysts*) and chemistry of materials (*Microporous and Mesoporous Materials, Crystal Growth & Design, Journal of Materials Science, Materials Letters*). The publications have been cited 273 times, as almost all citations are in international journals. These scientific achievements are completely sufficient to meet all the minimum national requirements stipulated in the Act for the Development of the Academic Staff in the Republic of Bulgaria.

In conclusion, the dissertation of Prof. Dr. Yuri Angelov Kalvachev fully meets all the minimum national requirements stipulated in the Act for the Development of the Academic Staff in the Republic of Bulgaria. The obtained results and the way of their presentation in the dissertation work show that Prof. Kalvachev is an established researcher with high scientific competence and I strongly recommend that he be awarded the scientific degree "Doctor of Sciences" in the professional field 4.2. Chemical sciences, scientific specialty: Chemical kinetics and catalysis.

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