

REVIEW



on a dissertation for the acquisition of the educational and scientific degree "**Doctor**"
in the field: 4.2. "Chemical Sciences",
scientific specialty: "Processes and devices in chemical and biochemical technology"

Scientific organization: Institute of Chemical Engineering – Bulgarian Academy of Sciences

Author of the dissertation: Eng. Stefan Martinov Stefanov , chemist at IChE-BAS

Topic of the dissertation : "*Fuel cells for environmental applications* "

Reviewer: Konstantin Mavrodiev Petrov , Professor, D.Eng., Eng. (IEES-BAS), member of the Scientific Jury, appointed by Order RD No. 09-23/19.06.2026 of the Director of IChE-BAS

1. Brief biographical information about the candidate.

Eng. Stefan Stefanov completed his Bachelor's degree in "Chemistry and Informatics" at the Faculty of Chemistry (now Faculty of Chemistry and Pharmacy) of Sofia University "St. Kliment Ohridski" in 2012 and his Master's degree in "Natural and Synthetic Fuels" at the University of Chemical Technology and Metallurgy – Sofia in 2015. As part of his Master's program, he completed a one-month internship at the Institute of Chemical Engineering - Bulgarian Academy of Sciences (2013), after which he was employed as a chemist, where he has been working to this day.

He was enrolled as a doctoral student on independent study at IChE-BAS in 2023, and with Protocol No. 9 of June 18, 2026, the Scientific Council of IChE approved his admission to dissertation defense.

He has participated in a total of 14 scientific projects: 5 funded by the National Science Foundation, 2 funded by international sources (under the EU's Seventh Framework Programme and the MSCA-RISE programme), 6 funded under operational programmes of the Ministry of Education and Science and other ministries, and 1 with a Bulgarian company (Iodum LTD).

He is a co-author of 33 scientific publications and has participated in 75 oral and poster presentations at scientific forums and seminars. During his PhD, he obtained 276 credits, compared with a required minimum of 200 credits.

2. Relevance of the problem.

The relevance of the dissertation topic in the field of ecology is undeniable. The treatment of natural and industrial streams contaminated with sulfur compounds has been a topic at IChE for

more than 30 years. Combining this extensive experience with fuel cell technology is a natural continuation of the research direction, especially in view of the national and international trends towards minimizing waste streams and generating energy from renewable sources.

The main goal of the dissertation is to evaluate the influence of key parameters on the electrochemical performance and efficiency of a fuel cell using aqueous solutions of sulfur compounds (sulfide and sulfite ions) as fuel.

3. General characteristics of the dissertation and the PhD student's knowledge of the state of the art in the field.

The dissertation contains 126 pages, 36 figures and 10 tables. The reference list includes 225 references, and the experimental work was carried out entirely at the IChE-BAS.

The dissertation contains the following sections: Introduction, Literature Review and Conclusions, Aim and Objectives of the dissertation, Experimental Research. Materials and Methods, Results and Discussion, Conclusions, Contributions, Future Work on the Topic, References and Appendices.

3.1. Literature review

The literature review is comprehensive, and its subsections are clearly and logically distinguished. Particular attention is devoted to sulfur compounds, currently applied and newly developed methods for their treatment, as well as to the different types of fuel cells, and the strengths and weaknesses of each type are systematized. Special attention is rightly paid to membrane fuel cells, since this type of fuel cell is used in the dissertation.

The conclusions from the literature review are well structured and serve as a logical basis for the formulation of the aim and objectives.

3.2. Motivation, aim and formulation of the objectives

Based on the literature review, the aim and objectives of the dissertation have been fully justified:

Aim: Experimental determination and evaluation of the influence of various parameters on the performance of a fuel cell for treatment of water contaminated with sulfur compounds.

The objectives are clearly structured, follow a logical sequence, and their achievement directly corresponds to the stated aim.

3.3. Experimental part

A substantial part of the dissertation is the presentation and discussion of the results obtained. The dissertation work represents a comprehensive experimental study of substantial scope. The successful solution of the tasks set in the dissertation requires a combination of chemical and electrochemical methods for the analysis of solutions and materials, allowing their comprehensive characterization.

At the beginning, the methods for chemical analysis of the various sulfur ions and compounds in solutions are presented very precisely. From my own experience, I know how laborious this analysis is, requiring a high level of expertise of the experimenter.

The main part involves determining the influence of various parameters on the performance of a modified fuel cell using unconventional fuel (sulfide or sulfite ions). The experiments performed are divided into separate subsections and follow a logical chain – each section concludes with an interpretation of the results obtained, and the next set of experiments is based on the best conditions already established in the previous ones. Various hypotheses have been formulated regarding the observed phenomena, which are subsequently experimentally validated.

The candidate's development in the field of electrochemical research is clearly evident here.

In conclusion, the PhD student has successfully addressed a number of challenging experimental and technological tasks, thereby laying a solid foundation for obtaining results of significant value to both theory and practice.

4. Main scientific and applied contributions of the dissertation.

The main contributions of the dissertation, in my opinion, relate to:

Methods for chemical analysis of various sulfur ions and compounds in solutions have been mastered and applied.

The influence of various parameters on the performance of a modified fuel cell using unconventional fuel (sulfide or sulfite ions) has been determined.

Various hypotheses have been formulated regarding the observed phenomena, which have subsequently been experimentally validated.

5. Assessment of the extent to which the dissertation represents the PhD student's own work.

I have known Eng. Stefan Stefanov for years. I have followed his work as a doctoral student at the IChE and I am convinced of his very good scientific and technological training in the field of chemical engineering and in particular in electrochemistry. From my personal impressions and the materials provided to me, I come to the conclusion that the dissertation represents, to a

significant extent, the PhD student's own work, with the substantial support and collaboration of his scientific supervisors.

6. Publications on the dissertation.

The results of the research conducted as part of the dissertation have been published in three scientific publications, one of which was published in a scientific journal with SJR and ranked in quartile Q 3 – Journal of Chemical Technology and Metallurgy; and another in a scientific journal with SJR and IF, ranked in quartile Q 1 – Applied Sciences. To date, the two articles have received one and 25 citations, respectively. These results, along with the four reports delivered at scientific conferences (three national and one international), clearly demonstrate the wide dissemination and scientific recognition of the research results. The results fully meet and even exceed the requirements for acquiring the educational and scientific degree "Doctor".

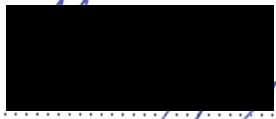
7. Assessment of the dissertation summary.

The dissertation summary accurately reflects the content of the dissertation and meets the formatting requirements.

8. Conclusion.

I hereby express my positive opinion on the dissertation submitted for defence and **I recommend** that the members of the Scientific Jury at IChE-BAS vote in favor of awarding **the educational and scientific degree "Doctor"** in field 4.2 "Chemical Sciences", scientific specialty "Processes and Apparatus in Chemical and Biochemical Technology" of **Eng. Stefan Martinov Stefanov**.

Sofia, 09 .09. 2026

Reviewer:

/ Prof. Konstantin Petrov/