OPINION

by Assoc. Prof. Dr. Stanimir Stoyanov Stoyanov,
Faculty of Chemistry and Pharmacy, Sofia University "St. Kliment Ohridski".

Subject: Dissertation for the acquisition of the educational and scientific degree "Doctor" in the professional field 4.2. Chemical Sciences (Physical Chemistry)

Topic of the dissertation: "Spectral and physicochemical properties of aerogel composite materials"

Author of the dissertation: Dimitar Nikolaev Shandurkov – PhD student at the Department of Physical Chemistry, Faculty of Chemistry and Pharmacy, Sofia University "St. Kliment Ohridski".

Supervisor: Prof. Dr. Stoyan Ivanov Gutsov,

The opinion was prepared in accordance with Order RD 38-591/30.09.2024 of the Rector of Sofia University and the decisions of the meeting of the Scientific Jury held on 14.10.2024.

The dissertation of PhD student Shandurkov is devoted to finding a reproducible method for synthesis, hydrophobization and functionalization of silicate aerogel granules and studying the dependence of their textural and spectral properties on the degree of hydrophobization. The topic is very relevant, as the search for new luminescent composite materials combining the specific properties of the individual components is a widely researched area in the field of modern materials science with many high-tech applications.

The dissertation is written on 120 pages, contains 51 figures and 9 tables, and 205 references. It is very well structured and includes the following main chapters: Introduction (5 pages), Goals and Objectives (1 page), Literature Review (57 pages), Experimental Part (33 pages), Conclusions (2 pages), Contributions (1 page) and Bibliography (15 pages). In the first two, a historical review of the composite materials used by man from ancient times to the present day is made, clearly positioning the subject of research in the wide palette of applications in various technologies and formulating clearly and concisely the main goals and objectives of the dissertation. The literature review describes in detail the methods for preparation, functionalization and studying aerogel materials, and the results achieved so far in the search for new luminescent composites around the world, and particularly, in the Department of Physical Chemistry of Sofia University.

The main part describes the experiments carried out and discusses the results from them. It is divided into two main chapters: the first one gives detailed results for the obtained new aerogel powders and granules with different degrees of hydrophobicity, the study of their structure with IR spectroscopy and their morphology using low-temperature isotherms of adsorption-desorption of nitrogen. The second chapter of the Experimental Part describes the preparation, structure and photophysical properties of luminescent composite materials based on SiO_2:[Eu(phen)$_2$](NO_3)$_3$ and SiO_2:[Tb(phen)$_2$](NO_3)$_3$. They were analysed with UV/Vis/NIR absorption spectra in diffuse reflectance mode, excitation and emission spectra, quantum yields and colour coordinates. XRD and thermal analyses were performed to study the stability of the composites. The conclusions made at the end of the dissertation summarize and accurately reflect the results obtained. The abstract reflects fully and correctly the results of the research.

Some of the results of the dissertation have been included in four publications – three in journals with an impact factor (two in the second quartile (Q2) and one in the third (Q3)), and one in a scientific conference proceedings without an impact factor. A total of six citations have already been noticed for two of them. The results have been presented at four scientific forums, two of which are international. Mr. Shandurkov is a co-author of six additional publications with a total of 44 citations (Scopus) and is a participant in three scientific projects.

Considering the thesis, the scientific research output, the conclusions made, and the publications, it becomes clear that the work has a pronounced innovative character with a high potential for application of the obtained and characterized new composite materials.

Conclusion: On the basis of the above, I believe that the growth of the PhD student and the quality of the contributions in the proposed dissertation meet the requirements of the Law (ZRASRB), the Regulations for its Implementation and the Recommended Criteria of the Faculty of Chemistry at Sofia University for Acquiring Scientific Degrees and Occupying Academic Positions in the Professional Field 4.2 "Chemical Sciences". I strongly recommend to the Scientific Jury to award to MSc. Dimitar Nikolaev Shandurkov the educational and scientific degree “Doctor” in the professional field 4.2 Chemical Sciences (Physical Chemistry).

25.11.2024 Member of the scientific jury:

Sofia /Assoc. Prof. Dr. Stanimir Stoyanov/