REVIEW

of the official reviewer for dissertation work of Bekissanova Zhanar on the topic: "Synthesis, characterization and antibacterial activity study of composites based on natural adsorbents and silver nanoparticles", submitted for the degree of Doctor of Philosophy (PhD) in Educational Program "6D072000 – Chemical technology of inorganic substances"

№	Criteria	Eligibility (one of the options must be checked)	Justification of the position of the official reviewer
1.	The topic of the thesis (as of the date of its approval) corresponds to the directions of development of science and/or state programs	1.1 Compliance with priority areas of science development or government programs:	
		1) The thesis was completed within the framework of a project or target program financed from the state budget (indicate the name and number of the project or program) 2) The thesis was completed within the framework of another state program (indicate the name of the program) 3) The dissertation corresponds to the priority direction of the development of science, approved by the Higher Scientific and Technical Commission under the Government of the Republic of Kazakhstan (indicate the direction)	The thesis was completed within the framework of grant funding from the Ministry of Education and Science of the Republic of Kazakhstan: GF 2021 AP09561734, GF for postdoctoral students under the project "Zhas Galym-2" AR14972864.
2.	Importance for science	The work makes/does not make a significant contribution to science, and its importance is well disclosed/not disclosed	The work makes a somewhat significant contribution to science, and its importance is well established
3.	The principle of independence	Self-reliance level: 1) High; 2) Medium; 3) Low; 4) No independence	1. High, based on the Opinion of the scientific supervisors, Profs Ospanova and Sprynskyy, as well as the authorship statements in every co-authored publication. It is also reflected in being the first co-author on a number of published articles.
4.	The principle of inner unity	4.1 Justification of the relevance of the thesis: 1) Justified; 2) Partially justified; 3) Not justified.	1. Justified. The research is dedicated to the synthesis of new antibacterial materials that can be used to treat or protect against drug-resistant bacteria.
		4.2 The content of the thesis reflects the topic of the thesis: 1) Reflects;	1. Reflects.

		2) Partially reflects; 3) Does not reflect	
		4.3. The purpose and objectives correspond to the topic of the thesis: 1) correspond; 2) partially correspond; 3) do not correspond	1. Correspond.
		4.4 All sections and provisions of the thesis are logically interconnected: 1) completely interconnected; 2) the interconnection is partial; 3) there is no interconnection	1. There is logical connection between provisions with a common theme of the synthesis of Ag/AgCl nanoparticles supported by mineral clay materials and confirming their antimicrobial properties
		4.5 The new solutions (principles, methods) proposed by the author are reasoned and evaluated in comparison with the known solutions: 1) there is a critical analysis; 2) partial analysis; 3) the analysis does not represent one's own opinions, but quotes from other authors	1. There is a critical analysis, in the form of a literature survey and comparison with existing methods and practical applications
5.	Scientific novelty principle	5.1 Are the scientific results and provisions new? 1) completely new; 2) partially new (25-75% are new); 3) not new (less than 25% are new)	2. Partially new – some of the materials used in this study, their synthesis and properties are very well established (Ag nanoparticles). The classes of the support materials used in this work to stabilize Ag nanoparticles (diatomite, kaolinite) appear to be studied well too. So, results are largely expected.
		5.2 Are the dissertation findings new? 1) completely new; 2) partially new (25-75% are new); 3) not new (less than 25% are new)	2. Partially new – findings are not totally unexpected (see justification 5.1).
		5.3 Technical, technological, economic or management decisions are new and reasonable: 1) completely new; 2) partially new (25-75% are new); 3) not new (less than 25% are new)	2. Partially new – the major novelty appears to be in the development of biosilica nanocomposites as well as in the use of diatomite and kaolinite materials with a specific origin (Kazakhstan).

6.	The validity of the main findings	All main conclusions are/are not based on scientifically significant evidence or well-grounded (for qualitative research and areas of training in the arts and humanities)	All main conclusions are based on scientifically significant evidence – the results were confirmed by many relevant modern methods and published in a series of articles in peer-review journals.
7.	The main provisions for the defense	It is necessary to answer the following questions for each provision separately: **Provision 1** 7.1 Is the provision proven? 1) proven; 2) rather proven; 3) rather not proven; 4) not proven 7.2 Is it trivial? 1) yes; 2) no 7.3 Is it new? 1) yes; 2) no 7.4 Application level: 1) narrow; 2) medium; 3) wide 7.5 Is it proven in the article? 1) yes; 2) no **Provision 2** 7.1 Is the provision proven? 1) proven; 2) rather proven; 3) rather not proven; 4) not proven 7.2 Is it trivial? 1) yes;	**Provision 1** 7.1. The provision is proven in the following articles: a) Z. Kubasheva et al., Materials 2020, 13, 3409; b) A. Toksanbay et al., Int. J. Biol. Chem. 14, 1, 184 (2021) New composite materials with antibacterial properties were successfully prepared and confirmed by a number of methods. 7.2. Not trivial 7.3. It is new largely in the sense of materials used for the study had a new origin (Kazakhstan-based diatomite). 7.4. The claimed application level of new materials is very broad based on common knowledge, although it has not been demonstrated in practical applications (e.g., wound dressings), hence the Medium level. 7.5. Same as 7.1 **Provision 2** 7.1. The provision is proven in the following articles: a) Z. Bekissanova et al., Coll. Surf. B: Biointerfaces, 220 (2022) 112908; b) B. Baltabayeva et al. MATEC Web of Conferences 340, 01030 (2021);

		2) no 7.3 Is it new? 1) yes; 2) no 7.4 Application level: 1) narrow; 2) medium; 3) wide 7.5 Is it proven in the article? 1) yes; 2) no **Provision 3** 7.1 Is the provision proven? 1) proven; 2) rather proven; 3) rather not proven; 4) not proven 7.2 Is it trivial? 1) yes; 2) no 7.3 Is it new? 1) yes; 2) no 7.4 Application level: 1) narrow; 2) medium; 3) wide 7.5 Is it proven in the article? 1) yes; 2) no **Provision 4**	c) A. Toksanbay et al., Int. J. Biol. Chem. 14, 1, 184 (2021) New composite materials with antibacterial properties were successfully prepared and confirmed by a number of methods. 7.2. Not trivial 7.3. It is new largely in the sense of materials used for the study had new origin (Kazakhstan-based kaolinite). 7.4. The claimed application level of new materials is very broad based on common knowledge, and it was demonstrated in developing antibacterial coatings. 7.5. Same as 7.1 **Provision 3** 7.1. The provision is proven in the following articles: a) I. Wojtczak et al., J. Clust. Sci. 35, 429–442 (2024) b) Z. Bekissanova et al., Biomimetics 2024, 9, 5. New composite materials with antibacterial properties were successfully prepared and confirmed by a number of methods. 7.2. Not trivial 7.3. New; A novel, controllable, and sustainable route to support substrates for Ag nanoparticles was developed. 7.4. The claimed application level of new materials is very broad based on common

		7.1 Is the provision proven? 1) proven; 2) rather proven; 3) rather not proven; 4) not proven 7.2 Is it trivial? 1) yes; 2) no 7.3 Is it new? 1) yes; 2) no 7.4 Application level: 1) narrow; 2) medium; 3) wide 7.5 Is it proven in the article? 1) yes; 2) no	knowledge, although it has not been demonstrated in practical applications (e.g., wound dressings), hence the Medium level. 7.5. Same as 7.1 **Provision 4** 7.1. The provision is proven in the following articles: a) Z. Kubasheva et al., Materials 2020, 13, 3409; b) Z. Bekissanova et al., Coll. Surf. B: Biointerfaces, 220 (2022) 112908; c) B. Baltabayeva et al. MATEC Web of Conferences 340, 01030 (2021); d) A. Toksanbay et al., Int. J. Biol. Chem. 14, 1, 184 (2021) e) I. Wojtczak et al., J. Clust. Sci. 35, 429–442 (2024) f) Z. Bekissanova et al., Biomimetics 2024, 9, 5. The antibacterial properties of the nanocomposite materials were successfully demonstrated by minimal inhibitory concentration method against gram-positive S.aureus and gram-negative K.pneumoniae, E.coli strains of bacteria from the typical collection cultures and clinical isolates 7.2. Not trivial 7.3. The novelty of this provision is not high as Ag and AgCl nanoparticles and their combinations are well-known and

			proven to have a broad antimicrobial effect. 7.4. The claimed application level of new materials is very broad based on common knowledge, although it has not been demonstrated in practical applications (e.g., wound dressings), hence the Medium level. 7.5. Same as 7.1
8.	The principle of reliability. Reliability of sources and information provided	8.1 Choice of methodology - is justified or the methodology is described in sufficient detail 1) yes; 2) no	1. Yes. The methods used in these studies are typical and standard for nanomaterials characterization.
		8.2 The results of the thesis were obtained using modern methods of scientific research and methods of processing and interpreting data using computer technologies: 1) yes; 2) no	1. Yes. The methods used in these studies are modern. Computer technologies were used to process and interpret the data.
		8.3 Theoretical conclusions, models, identified relationships and patterns have been proven and confirmed by experimental research (for areas of training in pedagogical sciences, the results have been proven on the basis of a pedagogical experiment): 1) yes; 2) no	1. Yes. Theoretical conclusions, models, identified relationships and patterns have been proven and confirmed by experimental research and published in a series of peer-reviewed articles.
		8.4 Important statements are confirmed / partially confirmed / not confirmed by references to current and reliable scientific literature	Important statements are confirmed by references to current and reliable scientific literature
		8.5 Used literature sources are sufficient/not sufficient for a literature review	Literature sources referenced in published research articles were sufficient as evidenced by the fact of publication of these articles that passed peer-review
9	Practical value principle	9.1 The thesis has theoretical value: 1) yes;	9.1 The thesis does have theoretical value, but it appears to be very limited

		2) no	without investigation toward practical applications of these nanocomposite materials (e.g., cytotoxic studies on cell lines and animal models; clay minerals' biocompatibility, etc.)
		9.2 The thesis is of practical importance and there is a high probability of applying the results obtained in practice: 1) yes; 2) no	1. Yes, but very limited. The probability of applying the obtained results in practice appears to be low without attempts to demonstrate practical applications beyond confirming antibacterial properties (e.g., work on developing product prototypes or studying biocompatibility)
		9.3 Are the practice suggestions new? 1) completely new; 2) partially new (25-75% are new); 3) not new (less than 25% are new)	3. Not new. Practical applications of silver-containing composites are not new.
10.	The quality of writing and design	Academic writing quality: 1) high; 2) average; 3) below average; 4) low.	1. High, as evidenced by the series of peer-reviewed articles

Notes:
The conducted work appears to be thorough and the results to be trustworthy. Despite these advantages, the work could have been made more impactful and relevant if the provisions were designed to be broader and include some or all of the following:

1) Thorough justification of the choice of support materials and their advantages over many other types of materials;
2) Other methods of Ag nanoparticle synthesis;
3) Systematic studies on how the size of nanoparticles in nanocomposites affects their antibacterial activity;
4) Experiments that compare antibacterial activities of pure Ag and AgCl nanoparticles in nanocomposites;
5) Experiments on studying cytotoxicity and biocompatibility of clays and nanocomposites;
6) Experiments on preparing the prototypes of formulations, e.g., wound dressings.

These comments, however, do not diminish the overall good impression and evaluation of this work.

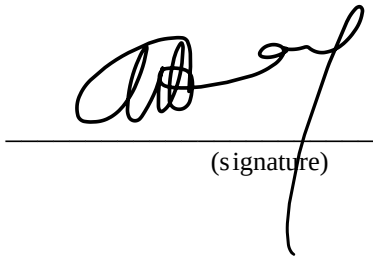
In reviews, official reviewers indicate one of the following solutions:

1) to award the degree of Doctor of Philosophy (PhD);
2) send the dissertation for revision;
3) send the dissertation for re-defense;
4) refuse to award the degree of Doctor of Philosophy (PhD) or Doctor of Philosophy.

Copies of the reviews of the official reviewers are handed over to the doctoral student no later than 5 (five) working days before the defense of the thesis.

Official Reviewer:

Managing Editor
American Chemical Society



Sergey Shmakov

(place of work, academic title) (signature) (FULL NAME)