

REVIEW

of dissertation for the acquisition of:

educational and scientific degree " doctor "	X
scientific degree " Doctor of Science "	
	the true is indicated by the sign "X"

Author of the dissertation:

Enj,		Ina	Stoyanova	Karadashka-Radeva	UCTM
academic position	scientific degree	name	middle name	last name	workplace

Topic of the dissertation:

"Synthesis and characterization of chalcogenide systems based on As₂Se₃"

Scientific area:

4	Natural Science
code	name

Professional area:

4.2	Chemical Sciences
code	name

Scientific specialty:

Inorganic chemistry

The review was written by:

academic position	scientific degree	name	middle name	last name	workplace

1. Completion of the provided documents:

A) The dissertation and the competition documents are in full compliance with the Regulations.	4 points	X
B) The documents are complete but do not fully comply with the requirements of the Regulations.	2 points	
C) The documents are not completed in accordance with the requirements of the Regulations.	0 points	

		one of the answers given is marked with the sign "X"
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Missing documents and violated standards must be described if response C is marked.

2. Meeting the minimum requirements under the Regulations:

A) The candidate meets the minimum requirements	20 points	X
B) The candidate doesn't meet the minimum requirements	0 points	
		one of the answers given is marked with the sign "X"

It must be filled in if answer B is marked. The publication activity of the candidate is analyzed. The response of the results achieved (quoted) is analyzed.

3. The relevance of the topic of the dissertation:

A) The topic is relevant and new (there are no known results on the topic by other authors)	8 points	X
B) The topic is relevant and results from other authors are known	6 points	
C) The topic is not relevant, but results from other authors are known	2 points	
D) The topic is not relevant and no results from other authors are known	1 point	
E) The topic does not correspond to the level of dissertation	0 points	
		one of the answers given is marked with the sign "X"

The evaluation of the relevance of the dissertation must be substantiated

The dissertation is dedicated to synthesizing and studying the properties of multicomponent chalcogenide glasses, which are the subject of research by scientists from the international scientific community due to their properties and their potential for many and varied applications - in information technology, energy, health care. This defines the topic of the dissertation work as relevant. New glasses were synthesized and glass-ceramics from the Ag₂Te systems were obtained from them – As₂Se₃ – CdTe, As₂Se₃ – Ag₂Te – GeTe and As₂Se₃ – GeTe – CdTe; Composition, structure, and mechanical properties were investigated. The areas of glass formation and dissolution kinetics in aggressive acid media were determined. The presented results are new and contribute to expanding the possibilities for obtaining multicomponent chalcogenide glasses with improved qualities and potential for their application.

4. Knowledge of the problems, subject of research in the dissertation:

A) The doctoral student knows in detail the achievements of other authors on the topic of the dissertation	8 points	X
B) The doctoral student is partially familiar with the achieved results on the topic of the dissertation	4 points	
C) The doctoral student has no prior knowledge of the status of the problems in the dissertation	0 points	
		one of the answers given is marked with the sign "X"

The evaluation must be substantiated if answer C is marked.

In a literature review in his dissertation work, the candidate's detailed knowledge of the current state of research of the international scientific community on the subject is shown, which contributed to conducting scientific research at a high level and obtaining interesting and new data, the results of which were published in articles in scientific journals and presented at scientific forums.

5. Type of research:

A) Theoretical	4 points	
B) Applied	4 points	X
C) Theoretical with application elements	4 points	
D) It does not correspond to the level of dissertation	0 points	
		one of the answers given is marked with the sign "X"

The level of research must be substantiated if answer D is marked.

The research has an applied nature - synthesis of oxide glasses and glass-ceramics and investigation of their properties, which have various potential applications for optical instruments, resistive sensors, lenses and CO₂ lasers.

6. Objectives of the research:

A) Realistic and of scientific and / or applied interest	8 points	X
B) Realistic, but not of scientific and / or applied interest	3 points	
C) Unattainable (unrealistic)	0 points	
		one of the answers given is marked with the sign "X"

Objectives must be specified. The type of the set objectives must be justified.

The goals of the research are clearly formulated: To synthesize new multicomponent chalcogenide glasses from the systems Ag₂Te – As₂Se₃ – CdTe, As₂Se₃ – Ag₂Te – GeTe and As₂Se₃ – GeTe – CdTe; To investigate their structure and physicochemical properties, to delineate the area of glass formation in these systems based on the obtained experimental results and to propose possibilities for their practical application; To investigate the degradation of chalcogenide glass samples in an aggressive environment. The objectives of the candidate's research are of great interest, both from a scientific point of view and from

the point of view of their practical application.

7. Methods of research:

A) Adequate to research and set objectives	8 points	X
B) Partially appropriate, enabling part of the scientific objectives and / or applications to be achieved	4 points	
C) Inappropriate methods	0 points	
		one of the answers given is marked with the sign "X"

Methods must be specified. The type of methods used is justified.

A traditional direct one-temperature synthesis method was applied to obtain the materials. A number of methods were used to study the composition, structure, solubility and mechanical properties: - X-ray phase analysis; - Electron microscopic analysis; - Differential thermal analysis; - Infrared spectroscopy with Fourier transformation; - Electronic paramagnetic resonance; - X-ray photoelectron spectroscopy; - Density measurement; - Measurement of microhardness by the Vickers method; Thermomechanical properties of the samples; Special attention is paid to studying the solubility of materials in an acidic environment. Appropriately chosen methods have contributed to the successful achievement of the research goals - clarification of the influence of the composition on the structure of the materials and on the mechanical and optical properties.

8. Contributions of the dissertation:

A) With lasting scientific and / or applied response, they form the basis for new research and applications	20 points	X
B) They are of significant scientific and / or applied interest, complete and / or summarize previous research	16 points	
C) They are of scientific and / or applied interest	12 points	
D) Lack of significant contributions	8 points	
E) Lack of contributions	0 points	
		one of the answers given is marked with the sign "X"

Contributions must be specified. The type of results achieved must be justified.

The contributions of the present dissertation have a significant fundamental and applied nature and represent a certain scientific and practical interest - materials of multicomponent chalcogenide glasses with new compositions were synthesized and their structure, phase composition and physical properties were investigated with the aim of obtaining multicomponent chalcogenide glasses with potential for application in electronics and sensor technologies: - For the first time, new chalcogenide glasses were obtained from three multicomponent systems: $\text{Ag}_2\text{Te} - \text{As}_2\text{Se}_3 - \text{CdTe}$, $\text{As}_2\text{Se}_3 - \text{Ag}_2\text{Te} - \text{GeTe}$ and $\text{As}_2\text{Se}_3 - \text{GeTe} - \text{CdTe}$, of which the glass formation regions were determined. - As_2Se_3 is a suitable glass former for all three systems. GeTe is a good modifier that expands the glass formation zone and stabilizes the glass structure. - Added to As_2Se_3 , GeTe , Ag_2Te and CdTe expand the transmittance of glasses in the mid-IR region of the spectrum (up to 400 cm^{-1}). - For the first time, the dissolution kinetics of samples of the synthesized chalcogenide glasses in an aggressive acidic environment was investigated.

9. Evaluation of the compliance of the dissertation summary with the dissertation:

A) Full compliance	4 points	X
B) Compliance of the main parts	2 points	
C) Lack of compliance of the main parts	0 points	
		one of the answers given is marked with the sign "X"

The evaluation must be substantiated if answer C is marked.

10. Participation of the doctoral student in the achievement of the results of the dissertation:

A) The doctoral student has at least an equal participation	8 points	X
B) The doctoral student has secondary participation	5 points	
C) The participation of the doctoral student is unnoticeable	0 points	
		one of the answers given is marked with the sign "X"

Critical notes must be provided if one of the items B or C is marked.

11. Critical notes:

A) Lack of critical notes	8 points	X
B) Critical notes of a technical nature	7 points	
C) Critical notes that would partially improve the results achieved	4 points	
D) Significant critical notes	0 points	
		one of the answers given is marked with the sign "X"

Critical notes must be provided if one of the answers C or D is marked.

12. Conclusion

A) The evaluation of the dissertation is POSITIVE	This evaluation is assigned to a total number of at least 65 points	X
B) The evaluation of the dissertation is NEGATIVE	This evaluation is assigned to a total number below 65 points	
		one of the answers given is marked with the sign "X"

To be filled in at the request of the reviewer

Eng. Ina Stoyanova Karadashka-Radeva has a point asset of 100 points, which exceeds the required minimum of 65 points defined in the Regulations on the terms and conditions for obtaining scientific degrees and for holding academic positions in UCTM and Art. 29, para. (1), item 5 of PPNSZAD.

The results of the research included in his dissertation have been published in 3 articles in scientific journals and have been presented at a large number of scientific forums. As a result of the conducted research, significant results have been obtained both from a fundamental point of view and from the point of view of practical application of the new synthesized multicomponent chalcogenide glasses for sensor applications and in opto-electronic systems.

I give the thesis work a "POSITIVE" rating.

With full conviction, I propose to the scientific jury to vote for awarding the scientific and educational degree "doctor" to Eng. Ina Stoyanova Karadashka-Radeva.

03.07.2024	The review was written by:	
date	Assoc. Prof. Dr. Stanislav Slavchev Slavov	signature