

REPORT

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:

		Nikita	Aleksandrovich	Lutchenko	Nazarbayev, University, Astana, Kazakhstan
academic position	scientific degree	name	middle name	last name	workplace

Topic of the dissertation:

Investigation of the possibility of obtaining an ultrafine-grained structure of zirconium alloys by methods of intensive plastic deformation
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Scientific area:

5	Technical Sciences
code	name

Professional area:

5.6.	Materials and Materials Science
code	name

Scientific specialty:

Materials science and technology of engineering materials

The report was written by:

Professor	Ph.D.	Rumyana	Lyubenova	Lazarova	IMSETHAC - BAS
academic position	scientific degree	name	middle name	last name	workplace

1. 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"
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It is mandatory to fill in if answer B is marked. The publication activity of the candidate is analyzed. The response of the results achieved (quoted) is analyzed.

The candidate has 6 articles on the dissertation topic, published in scientific journals, of which 3 have an impact factor and 1 has an impact rank. In one of the publications, he is in first place in the collective. He also has 8 reports at scientific conferences.

The total number of publications of the candidate in refereed journals in Scopus is 21, and the citations are 58, which is a very high result for a young scientist.

2. 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 study of the application of radial shear rolling to obtain zirconium alloys with an ultrafine-grained structure and improved mechanical properties, texture, and radiation resistance is a current scientific topic, since its development is necessary for modern nuclear power.

It is quite new, since radial shear rolling began to develop intensively after ~2010, and systematic research began mainly after 2015–2020. There are very few published systematic studies on the topic of obtaining an ultrafine-grained structure of zirconium alloys by means of radial shear rolling.

3. Type of research:

A) Theoretical	4 points	
B) Applied	4 points	
C) Theoretical with application elements	4 points	X
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 development has both a theoretical and experimental nature and is practically focused on nuclear energy.

4. 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.
<p>The applicant has formulated the following goals and objectives:</p> <ul style="list-style-type: none"> - to analyze the modern requirements for structural materials used for the active zones of nuclear reactors, to identify the key mechanisms of degradation under radiation conditions, and the feasibility of using ultrafine-grained (UFG) structures based on zirconium alloys; A realistic goal, representing scientific interest. - to summarize and classify existing methods for obtaining a UFG structure and to assess their applicability to zirconium alloys, taking into account scalability, product geometry, and reactor operating conditions; A realistic goal, representing scientific and applied interest. - to develop a technological scheme for radial-shear rolling of a zirconium alloy, using the finite element method for modeling the rolling process, to study the features and regularities of the stress-strain state of the metal during rolling, and to optimize the geometric and technological parameters of rolling; A realistic goal, representing scientific and applied interest. - to implement a series of experimental rollings on a radial-shear rolling mill to obtain rolled bars (blanks) with different diameters for analysis and assessment of the change in the microstructure of the alloy; A realistic goal, representing scientific and applied interest. - to study the evolution of the microstructure along the cross-section of the bars (blanks) obtained by radial shear rolling using transmission and scanning electron microscopy methods, including EBSD mapping, as well as analysis of the texture characteristics (including calculation of Kearns parameters); A realistic goal, representing scientific and applied interest. - to study the fine structure of the samples obtained by radial shear rolling using a high-resolution electron microscope A realistic goal, representing scientific and applied interest. - to obtain experimental data on the mechanical properties of the bars obtained from the studied zirconium alloy by radial shear rolling; Realistic and of scientific and applied interest. - to irradiate samples of the studied zirconium alloy with heavy ions to simulate the conditions of damage by fission fragments in the reactor cores. A realistic goal, representing scientific and applied interest.

5. Contributions of the dissertation:

A) With lasting scientific and / or applied response, they form the basis for new research and applications	20 points	
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.
<p>Scientific contributions:</p> <p>1. An original scientific systematic approach to the study of the technology of radial shear rolling as a method for intensive plastic deformation of zirconium alloys has been created and implemented, including: modeling, experimental rolling, microstructural analysis, analysis of mechanical properties, and testing of radiation resistance. Original results have been obtained that have no analogue in the existing scientific literature. A</p> <p>2. The possibility of successful application of the RSW method to zirconium alloy E110 has been studied. The regularities of formation and evolution of the UFZ structure and its influence on the mechanical properties in the obtained samples have been studied. The obtained data expand the fundamental concepts of the mechanisms of formation of the grain structure and texture in zirconium alloys during RSW. A</p> <p>3. The physical mechanisms for increasing the strength properties and radiation resistance when reducing the grain size to the UFZ level have been substantiated. It has been established that the high density of grain boundaries contributes to the formation of a stable structure and improvement of the complex material properties. A</p> <p>Scientific and applied contributions</p> <p>A technology for forming a UFZ structure in zirconium alloys by methods of intense plastic deformation, in particular radial shear rolling (RSR), has been developed and experimentally confirmed, with subsequent analysis of the structural and operational characteristics of the resulting material. A</p> <p>Applied contributions:</p> <p>1. The possibility of producing long parts (rods) of different diameters from a zirconium alloy by applying the developed RSR technology has been experimentally confirmed, resulting in a rod with a gradient structure and a high degree of grain fragmentation. A</p> <p>2. A technology applicable in the industrial production of structural materials with improved operational properties, structure of the surface layers of the blank, and crystallographic texture is proposed, opening up new prospects in the field of creating highly efficient materials for nuclear power (with increased radiation resistance and high mechanical properties during long-term operation). The data obtained can be used in the development of new technologies for the production of fuel tubes with increased service life and safety. A</p>

6. Conclusion

A) The evaluation of the dissertation is POSITIVE	This evaluation is assigned to a total number of at least 40 points	X
B) The evaluation of the dissertation is NEGATIVE	This evaluation is assigned to a total number below 40 points	
		one of the answers given is marked with the sign "X"

To be filled in at the request of the member of the scientific jury
An excellent dissertation (both in content and layout), which I rate at the maximum number of points - 60.

18.02.2026	The report was written by:	
date	Prof. Romyana Lazarova, Ph.D.	signature