

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	Alexandrovich	Lutchenko	
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 severe plastic deformation

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:

Associated Professor	PhD	Daniela	Lyubomirova	Grigorova	University of Chemical Technology and Metallurgy (UCTM), Sofia
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"

In accordance with the Law on the Development of the Academic Staff in the Republic of Bulgaria, its Implementing Regulations, and the Regulations of the University of Chemical Technology and Metallurgy

(UCTM), Eng. Nikita Alexandrovich Lutchenko fully meets the minimum requirements for the award of the educational and scientific degree "Doctor" (PhD) in Professional Field 5.6 Materials Science.

According to the submitted report (Appendix 1z), the candidate has accumulated a total of 125.90 points, significantly exceeding the required minimum. The dissertation topic is supported by 6 scientific publications, 4 of which are published in refereed and indexed journals in internationally recognized databases, as well as 6 registered citations in international scientific sources. The results have been presented at 7 scientific forums, and the candidate has participated in 3 research projects. All required educational documents and official enrollment and completion orders with the right to defense have been submitted. Therefore, I consider that the candidate fully complies with the established quantitative and formal criteria.

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 topic of the Ph.D Thesis is unquestionably relevant and scientifically significant, as it is directly related to improving the safety and operational reliability of materials used in nuclear energy. Zirconium alloys employed as cladding materials for fuel elements operate under high temperatures, pressure, and intense neutron irradiation, leading to radiation growth, hardening, creep, and embrittlement. Limiting these degradation processes requires new structural approaches based on grain size and crystallographic structure control.

The formation of an ultrafine-grained structure through severe plastic deformation methods represents a modern research direction; however, existing studies are predominantly limited to small-scale laboratory specimens. There is a lack of systematic developments aimed at producing ultrafine-grained structures in long-length zirconium semi-products with potential for real reactor applications.

The scientific novelty of the Ph.D thesis lies in the development and experimental validation of a technological approach for radial-shear rolling of E110 alloy, combined with computer modeling and process optimization. For the first time, a material database for this alloy was created within the DEFORM-3D environment based on the author's plastometric investigations, enabling reliable prediction of the stress-strain state. The integrated combination of numerical modeling, full-scale experiments, and microstructural analysis at an industrially relevant scale substantiates the clear scientific novelty and high relevance of the thesis.

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 Ph.D thesis, clearly represents theoretical research with elements of application. From a theoretical perspective, models of the stress–strain state during radial-shear rolling were developed and analyzed using the finite element method, including the creation of an original material database for E110 alloy in DEFORM-3D based on plastometric testing. Optimization of technological parameters was performed through numerical modeling and analysis of deformation, stress distribution, and hydrostatic pressure.

At the same time, the work contains significant applied elements, including full-scale rolling experiments, comprehensive microstructural investigations (SEM, TEM, EBSD), mechanical testing, and radiation resistance studies via ion irradiation. The developed technological approach is aimed at producing long-length semi-products applicable in nuclear energy, giving the research clear engineering relevance.

The combination of fundamental analysis, numerical modeling, and experimental verification at an industrially relevant scale justifies the classification of the work as “Theoretical with elements of application.”

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.

The dissertation formulates a main purpose: to investigate the possibility of obtaining an ultrafine-grained structure in zirconium alloys through severe plastic deformation methods, with emphasis on radial-shear rolling.

To achieve this objective, a sequence of tasks was defined: development of a finite element numerical model and creation of a material database, optimization of technological parameters, experimental validation, and microstructural and mechanical characterization of the processed material, including assessment of radiation resistance.

The purposes are scientifically justified, logically structured, and fully accomplished within the framework of the research. They combine fundamental investigation of structure formation mechanisms with clear applied potential for reactor semi-product manufacturing. Although the formulation merges purpose and tasks within a single block, substantively they represent a clearly structured system of achievable and scientifically significant sub-purposes.

5. 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 dissertation contains scientific and scientific-applied contributions of lasting character, with potential to develop new research and technological directions in materials science and nuclear engineering.

The scientific contributions include the development and validation of a numerical model of the radial-shear rolling process for E110 alloy using the finite element method, including the creation of an original material database based on the author's plastometric investigations. The regularities governing deformation distribution, stress state, and conditions for the formation of a gradient ultrafine-grained structure in long-length billets have been established. The mechanisms of structure formation under complex non-monotonic deformation have been clarified, and the possibility of controlling texture and microstructural parameters has been demonstrated.

The scientific-applied contributions include the development of a technological scheme for producing ultrafine-grained zirconium in dimensions relevant to real reactor applications, as well as experimental confirmation of enhanced mechanical properties and potential improved radiation resistance. The integration of modeling, experimentation, and structural analysis at an industrially significant scale provides a foundation for implementation and for further research on SPD technologies for zirconium alloys.

The obtained results go beyond summarizing known approaches and extend the application of radial-shear rolling to high-technology nuclear materials. The depth of analysis, methodological complexity, and convincing experimental validation demonstrate the high scientific maturity and independence of the Ph.D. candidate.

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

I consider that the submitted Ph.D. Thesis respond the requirements of the Bulgarian Law on the Development of the Academic Staff and the Regulations of UCTM for awarding the educational and scientific degree "Ph.D." The work is characterized by relevance, scientific novelty, in-depth analysis, and significant applied potential, and its contributions are substantial and demonstrate long-term scientific and applied impact.

Based on the above, I award the dissertation the maximum possible score — 60 points

I propose that the esteemed scientific jury award Master. Nikita Alexandrovich Lutchenko the educational and scientific degree Ph. D. (Doctor) in Professional Field 5.6 Materials Science.

16.02.2026 r.	The report was written by:	
date		signature