

REVIEW

to occupy the academic position:

"Professor"	X
"Associate Professor"	
	one of the academic positions indicated shall be marked with the sign "X"

Candidates to occupy the position:

1	Assoc. Prof.	PhD	Rozina	Mihaylova	Yordanova	University of Chemical Technology and Metallurgy
№	academic position	scientific degree	name	middle name	last name	workplace

Scientific area:

5	Technical sciences
code	name

Professional area:

5.9	Metallurgy
code	name

Scientific specialty:

Plastic deformation processing technologies, machines and systems

The competition has been announced:

68	13.08.2024	Physical Metallurgy and Thermal Aggregates (FMTA)	Faculty of Metallurgy and Materials Science (FMM)
in SG issue	date	for the needs of the Department	Faculty

The review was written by:

Professor	PhD	Stoyko	Atanasov	Gyurov	Institute of Metal Science, equipment, and technologies with Center for Hydro- and Aerodynamics "Acad. A. Balevski" BAS
academic position	scientific degree	name	middle name	last name	workplace

1. Review for the candidate:

Assoc. Prof.	PhD	Rozina	Mihaylova	Yordanova
academic position	scientific degree	name	middle name	last name

1.1. Completion of the provided documents:

A) The competition documents are in full compliance with the Regulations	3 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"

Missing documents and violated requirements must be described if response C is marked.

There are no missing documents.

1.2. 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.

Associate Professor Yordanova, PhD submitted a total of 61 scientific publications for the competition, including:

- 28 pcs. scientific publications in journals that are referenced and indexed in world-renowned databases of scientific information - Scopus Author ID: 55356140100; <https://orcid.org/0000-0002-5569-4957>, distributed by NACID indicators 4 and 7 as follows: 14 pcs. to indicator 4: - scientific publications with numbers from [A1] to [A14], united in the form of a habilitation thesis on the topic "Metallic materials and products - production, properties and behaviour under monotonic and cyclic loads"; 14 pcs. to indicator 7: - scientific publications with numbers from [15] to [28].

- 29 pcs. scientific publications in non-refereed peer-reviewed journals or in edited collective volumes numbered [29] to [57] referred to indicator 8.

- 2 pcs. published university textbooks, [58, 59] referred to indicator 23;

- 2 pcs. published textbooks, [60, 61] referred to indicator 24.

A total of 43 citations of the presented works were noted, 37 of them in Scopus. The Hirsch index (H-index) is 3, according to the information presented in the world scientific database Scopus (Scopus Author ID: 55356140100).

Assoc. prof. Yordanova, PhD has led 1 research project and participated in 1 national one a scientific project with an economic organization, as well as in another 14 national projects under operational programs (OP), co-financed by the EU through European Funds (EF).

The NACID reference (Table 1) shows: Indicator 1 – 50 points out of the required 50; Indicator 4 – 102.4 points out of a required 100; Sum of indicators 5 to 11 - 274.81 points with required 200; Sum of indicators 12 to 15 - 386 points with required 100; Sum of indicators 16 to the end - 327.67 points out of 100 required.

Assoc. prof. Rozina Mihailova Yordanova, PhD exceeds the minimum national indicators for the position "Professor".

1.3. Relevance of scientific and / or applied research:

A) The research is relevant. Part of the research is pioneering (no results are known on the topic by other authors)	7 points	
B) Research is relevant. Results from other authors are known for each of the topics and / or applications studied.	5 points	X
C) Most of the research is relevant, but also some results are presented that have no scientific and / or applied value	3 points	
D) The smaller part of the research is relevant	2 points	
E) Research is not relevant	0 points	
		one of the answers given is marked with the sign "X"

The evaluation of the relevance of the research must be substantiated.

The works of Assoc. prof. Yordanova, PhD can be divided into the following main ones thematic directions:

1. *Research, analysis and mathematical modelling of the fatigue behaviour of steels based on experiments to track the propagation of short fatigue cracks* [A1-A6, A6a, A7, A7a, A8, A9, A9a, 15, 29, 30, 31, 32, 34-38, 56, 57].

Fatigue in metals and alloys is a process of gradual accumulation of fatigue cracks as a result of repeated alternating loads, in which the strength of the material is progressively reduced.

The mechanism and kinetics of fatigue crack propagation in detail is not fully understood, which makes research on the subject relevant.

2. *Research and evaluation of modern technological processes in processing ferrous and non-ferrous metallurgy with a view to their improvement* [A10, A10a, A11, 16-26, 39, 40-48, 58, 59, 61].

Research on the structure and physico-mechanical properties of rolled products from steels, copper and copper alloys, zinc and aluminium alloys provides new information for evaluating existing technologies for processing metals by plastic deformation. The analysis of the obtained results is the basis for improving the processes and technologies, while preserving or increasing the quality, simultaneously with the realization of an economic, energy or ecological effect.

3. *Research of metallic materials with special purpose* [17, 19, 20, 27, 28, 33, 52, 53, 53a, 54, 54a, 55, A14].

Original research was carried out on the composition, structure, properties of cutting-edge metal materials and special purpose products - stainless steel and titanium-molybdenum alloy orthodontic arches; steel wire rope for the mining industry; superconducting strips obtained by the OPIT method (Oxide Powder in a Tube); surface modified stainless steel 316L by electron beam technology. As a result of the research, new, useful for practice data were obtained on the relationship between composition, structure and properties.

4. *Preparation and study of the microstructure and properties of materials and alloys with increased resistance indicators and limited deformation possibilities* [49, 50, 51, A12, A13].

The influence of alloying elements on the structure formation and mechanical parameters of heat-treated iron-based alloys with an increased concentration of C and a constant high content of Mn and Cr was investigated.

The structure and influence of nitrogen of high-nitrogen cast steels on the structure formation, type and morphology of the existing phases were investigated.

The influence of Fe-Si-Mg-REM inoculants of different shape and structure on the microstructure of cast iron with vermicular graphite.

The phases of chromium carbides formed during a high-temperature carbidization process (1600°C and different isothermal holding times) of metallic Cr-particles with carbon powder were studied in the conditions of an electro thermal rotating bed (ETRB). Microstructural characterization of Cr-particles under different carbidization regimes was carried out.

The development and optimization of metallic materials is a current research task, as metallic materials have a major role in shaping today's high-tech world. The research conducted by the candidate is up-to-date and aims to create and study the properties of new materials and processes, as well as their application in all spheres of life, medicine and industry.

1.4. Knowledge of the problems subject of research:

A) The candidate knows in detail the achievements of other authors on the researched topics and/or applications	6 points	X
B) The candidate is partially familiar with the achieved results on the researched topics and / or applications	4 points	
C) The candidate has no prior knowledge of the status of the researched problems	0 points	
		one of the answers given is marked with the sign "X"

The evaluation must be substantiated if answer C is marked.

Assoc. prof. Yordanova, PhD is visible in Scopus with 32 publications, of which 21 are cited. In these publications, the literary sources cited by the candidate, related to the developed problem, are between 10 and 30 pieces per publication and are mainly of authors who published after 2005. It is obvious that the candidate follows the news in the field of her scientific interest. I can confidently state that Assoc. prof. Yordanova, PhD knows in detail the achievements of other authors on the researched topics.

1.5. Type of research:

A) Theoretical	4 points	
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B) Applied	4 points	
C) Theoretical with application elements	4 points	X
D) It does not correspond to the level specified in the Act for the Development of the Academic Staff in the Republic of Bulgaria and the Regulations	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 candidate conducts both theoretical and applied research.

1.6. Objectives of the research:

A) Realistic and of scientific and / or applied interest	8 points	
B) Realistic, but not of scientific and / or applied interest	4 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 candidate's research fully corresponds to the level defined in the Act on development of the academic staff in the RB and the Regulations to it and the Regulations for the acquisition of scientific degrees and the occupation of academic positions at UCTM. They can be defined as scientific - *modelling of the fatigue process* [A1-A6, A6a, A7, A7a, A8, A9, A9a, 15, 29, 30, 31, 32, 34-38, 56, 57]; scientific applied - *research of metallic materials with special purpose* [17, 19, 20, 27, 28, 33, 52, 53, 53a, 54, 54a, 55, A14]; and applied - *research and evaluation of modern technological processes in processing ferrous and non-ferrous metallurgy with a view to their improvement* [A10, A10a, A11, 16-26, 39, 40-48, 58, 59, 61], as well as *obtaining and research of the microstructure and properties of alloys with increased resistance indicators and limited deformation capabilities* [49, 50, 51, A12, A13]. Proof of the realism of the research goals is the large number of publications referenced in Scopus - 32 works, of which 21 are cited.

1.7. Methods of research:

A) Adequate to research and set scientific objectives and /or applications	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.

The candidate applies a variety of methods, modern experimental and theoretical research techniques, adequate to the set goals.

Mathematical methods: - Methodology for calculating the microstructural barriers that define the three-mode growth of the short fatigue crack; - Method for analysis, assessment and prediction of the behaviour of short fatigue cracks; - Parabolic-linear Yordanova model; - Alternative linear model of Angelova; - Computer modelling with the program *Deform*; - Computer modelling with the *MAGMASoft* software package.

Analytical methods: - optical microscopy, including 3D; - SEM microscopy (including in situ) combined with energy dispersive analysis (EDS); - dynamic and static mechanical tests; - surface roughness; - electrical conductivity.

Experimental methods: - replication technique for observation and microscopic measurement of fatigue cracks obtained on test specimens tested on machines developed at UCTM under loading schemes: "bending during rotation"; "pure symmetrical bending"; "stretch-stretch"; "tension-compression" and "full reversible torsion"; - OPIT method (Oxide powder in a tube); - electron beam treatment of the surface; - high-temperature process of carbidization of Cr-particles with carbon powder, in the conditions of an electro thermal rotating bed (ETRB); - equal channel angular pressing (ECAP) and the "Linex" scheme; - forging in dies with a specific design; - radial shear rolling.

1.8. Candidate research contributions:

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	X
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.

1. The initiation and propagation of short fatigue cracks was followed by applying a replication detection, tracking and measurement technique.
2. Original data on the propagation of short fatigue cracks in various steels (structural, stainless, spring and tool) were obtained.
3. Original data were obtained for the length of the short fatigue crack depending on: the applied number of load cycles; the fatigue life time at a given load amplitude; fatigue crack propagation rate; the fatigue crack propagation path through the steel microstructure; the surfaces (breaks) of destruction; the influence of hydrogen in steels.
4. Yordanova's parabolic-linear model was developed for calculating the fatigue life of the material. The model is verified with data from tests of different materials. The good convergence of the data from the experiment and the model allows the adequate prediction of the fatigue behaviour and the fatigue life time.
5. A complete parabolic-linear model is presented for the first time to describe the complex master crack developing in a flat pre-notched specimen subjected to "pure bending" fatigue.
6. Original data of failure surfaces of specimens tested under fatigue under different loading schemes were obtained by 3D microscopy.
7. For the first time, the "Crack Growth Rate - Crack Length" dependences were constructed for EN 10270-1SH spring steel.
8. New experimental data obtained on the fatigue life of a 316L steel specimen subjected to "accumulation damage".
9. The influence of hydrogen on the fatigue processes in steels was established through comparative analyses of the results obtained during the testing of non-hydrogenated and pre-hydrogenated test specimens.
10. The possibility of improving technological processes for processing ferrous and non-ferrous metals through plastic deformation has been proven, based on the determined physical and mechanical characteristics of the final products obtained.
11. The influence of: cast metal composition; casting modes; of hot and cold deformation; and heat treatment modes affecting the production of metallic materials with certain qualities.
12. An advanced mode of normalizing steel rolling is proposed to obtain a sheet with characteristics meeting the standard.
13. New data were obtained on the influence of impurities in electrolytic copper on its electrical conductivity and an optimized composition was proposed.
14. A new and original way of graphically presenting and analysing the relationship between the rolling technology and the physico-mechanical properties of the finished product (steel sheet and copper strip) is proposed, through which a general assessment of the applied rolling technology can be made,

as and be used to predict the physico-mechanical behaviour of the copper strip under service conditions.

15. Two technological modes for cold rolling of ZnCuTi alloy are proposed, investigated and analyzed in production conditions.

16. An advanced technological scheme for cold rolling of foil of aluminium alloy 3003 with a thickness of 0.048 mm and of aluminium alloy 8011A, for the production of finstock with a thickness of 0.24 mm, is proposed.

17. A theoretical study of the deformation process was carried out using the finite element method and the *DEFORM* program and developed: - a new technology for forging blanks in step-wedge dies; - new technological scheme for improving the production process of rebar profile; - new unconventional combined processes for the deformation of metals, with a view to improving their structure and properties.

18. An advanced technology for grinding working rolls is proposed, based on a mathematical model that takes into account the temperature deformations of the rolls that occur in contact with the hot strips during rolling

19. Original data were obtained on the properties and life of fabricated AISI 304 stainless steel orthodontic arch in real orthodontic treatment.

20. Original data on the surface characteristics (roughness) of hand-made loops on an orthodontic arch were obtained.

21. The serviceability and residual resource of steel wire rope for the mining industry has been established.

22. Laboratory technology for obtaining superconducting tapes by the OPIT method (Oxide powder in a tube) has been improved.

23. The coefficient of thermal conductivity of aluminium foam of alloy A356 in the temperature range [300°C-742°C] was determined by applying simulation and identification procedures using the *MAGMASoft* software product.

24. A technology for recycling by plastic deformation of ferrous metal scrap is proposed.

25. The influence of alloying elements on the structure formation and mechanical parameters of thermally treated (homogenization and aging) iron-based alloys with an increased concentration of C and a constant high content of Mn and Cr was established.

26. New data were obtained on the influence of nitrogen on the structure formation, type and morphology of the existing phases of high-nitrogen cast steels.

27. The influence of Fe-Si-Mg-REM inoculants of different shape and structure on the microstructure of cast iron with vermicular graphite was established.

28. The optimal carbidization parameters of metallic Cr-particles with carbon powder under the conditions of an electrothermal rotating bed (ETRB) were determined.

1.9. Participation of the candidate in the achievement of the presented results:

A) The candidate has at least an equal participation in the submitted papers	8 points	
B) The candidate has at least an equal participation in most of the submitted papers	7 points	X
C) The candidate has a secondary participation in most of the submitted papers	4 points	
D) The candidate participation 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 C or D is marked.

Associate Professor Yordanova, PhD presented sixty-one collective works for the competition, in eleven of which she won first place, and in twenty-five works she came second. In thirteen papers, the candidate is a co-author with Prof. Donka Angelova. The distribution protocols show participation between 5-7% for Associate Professor Yordanova, PhD in these works, which makes me think that the main weight, ideas and concepts, obviously belong to Prof. Angelova. In the remaining forty-eight papers, the participation of the candidate is at least equal.

1.10. Pedagogical activity:

A) The candidate has effective and sufficient pedagogical activity at the university. The textbooks issued are modern and useful (they meet the requirements of the Regulations). The work with undergraduate and doctoral students is at a high professional level.	8 points	X
B) The candidate has sufficient pedagogical activity at the university. The textbooks issued satisfy the requirements of the Regulations.	6 points	
C) The pedagogical activity and / or textbooks issued are insufficient (do not meet the requirements of the Regulations)	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.

Assoc. Prof. Yordanova, PhD is a co-author of two university textbooks and two university study aids, as well as three study aids for business. She supervised the diploma theses of thirty-six successfully defended students - twenty-four Masters and twelve Bachelors. He is the supervisor of four doctoral students, one of whom has defended his thesis, and three are in the process of training.

Over the past five years, Prof. Yordanova has developed and led: eight lecture courses for the Bachelor's degree program and eight lecture courses for the Master's program in Bulgarian; two lecture courses in English; four courses in Russian; three courses for PhD students and three courses at the request of the business.

1.11. Critical notes:

A) Lack of critical notes	8 points	
B) Critical notes of a technical nature	7 points	X
C) Critical notes that would partially improve the results achieved in a small part of the research	5 points	
D) Critical notes that would partially improve the results achieved in most of the research	3 points	
E) 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, D or E is marked.

I recommend that the applicant submit a patent application for research results that are novel, have an inventive step and are industrially applicable.

1.12. Conclusion

A) The evaluation of the candidate's activity is POSITIVE	This evaluation is assigned to a total number of at least 65 points	88 points X
B) The evaluation of the candidate's activity 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 if requested by the reviewer

Assoc. Prof. Rozina Mihailova Yordanova, PhD meets and exceeds all requirements of the Act on development of the academic staff in the RB and the Regulations to it and the Regulations for the acquisition of scientific degrees and the occupation of academic positions at UCTM. Bearing in mind the scientific achievements of the candidate, the topicality of the topics in her research activity and

her active teaching activity, I strongly recommend the Faculty Council of the Faculty of Metallurgy and Materials Science (FMM) to award Assoc. Prof. Rozina Mihailova Yordanova, PhD the academic position of "Professor", in the field of higher education 5. Technical sciences, Professional direction 5.9 Metallurgy, in Scientific specialty "Technologies, machines and systems for processing by plastic deformation", for the needs of the Department of Physical Metallurgy and Thermal Aggregates (FMTA).

11.11.2024	The review was written by:	
date	Prof. Stoyko Atanasov Gyurov, PhD	signature