

REVIEW

**in a competition for the academic position of "Associate Professor" in
Field of higher education 5. Technical sciences
Professional direction 5.1. Mechanical Engineering,
Study discipline "Technology of materials"**

announced in State Gazette No. 2/05.01.2024 by the Technical University - Varna for the needs of the "Materials Science and Materials Technology" department at the Faculty of Mechanical Engineering.

REviewer: Prof. Eng. Galya Velikova Duncheva, Dsc, PhD

1. Brief biographical data

The sole candidate is Eng. Tatiana Mitkova Mechkarova, PhD, born on 13.12.1979. Eng. Tatiana Mechkarova is an assistant in the department of "Materials Science and Technology" at the Faculty of Mechanical Engineering of the Technical University – Varna since 2007. The candidate is PhD in the scientific specialty "Engineering Materials Technology" since 2015. He has professional experience as a designer of facilities and installations in the chemical, oil, food and pharmaceutical industries since 2007 until the end of 2023, accumulated successively in "Himproekt Devnya" OOD, "Promproekt" OOD and "JES project" OOD, city of Varna.

2. Overview of the presented materials

As. Tatyana Mitkova Mechkarova, PhD, participated in the competition with a total of 48 scientific publications, divided into two groups: 1). Scientific works published in indexed and referenced editions of Scopus and WoS - a total of 11 (B4.1 - B4.11), presented as equivalent to a habilitation work; 2). Scientific publications in non-refereed editions with scientific review - a total of 37 scientific papers. According to the publication level, the presented 48 scientific publications are divided into the following categories: 1 scientific article in the journal Materials, MDPI (WoS, Q1); 2 scientific journal articles with SJR; 8 scientific articles in refereed journals (Scopus); 30 scientific publications in peer-reviewed journals; 9 reports at scientific forums (conferences and congresses) in Bulgaria. Thematically, all publications are in the field of the competition and have the character of research scientific works.

The applicant's asset by groups of indicators in accordance with the ZRASRB /2019 is as follows:

▶ Group A, indicator 1: Dissertation work for the award of the PhD on the topic "Optimization and research of indirect plasmatron for chemical-thermal treatment of titanium alloy Ti -6Al-4V" (2015);

▶ Group B, indicator 4: A total of 11 scientific articles in English, submitted for the equivalent of a habilitation thesis on the topic: "Investigation of the structure and properties of materials in various technological processes", distributed according to the place of publication, as follows: 1 scientific article in international journal Materials with IF 3.4 (2022) (B4.10); 2 scientific articles in UPB Scientific Bulletin, Series D: Mechanical Engineering with SJR 0.172 (2022) (B4.2 and B4.3); 5 scientific papers in IOP Conf. Series: Materials Science and Engineering (Scopus) (B4.4, B4.5, B4.7, B4.8, B4.9); 2 scientific articles in TEM Journal –

Technology, Education, Management, Informatics (WoS, Scopus); 1 scientific article in Proceedings of the Second International Scientific Conference "Intelligent information technologies for industry", 2017;

All publications from group B4 are co-authored without participation of the candidate as the first author. As. Tatiana Mechkarova, PhD, is second author in 5 scientific articles, third author - in 4 articles and fourth and seventh author in the remaining two. In total, according to this indicator, the candidate's asset is 145.57 points.

► Group G, Indicator 8: A total of 37 scientific publications in non-refereed journals and peer-reviewed journals, distributed in the following categories: 4 articles in foreign journals, of which 2 articles in Indian J. of Production and Thermal Engineering (IJPTE) (India) (G8.22 and G8.23), 1 article in The Annals of "DUNAREA DE JOS" University of Galati Fascicle IX (Romania) (G8.27) and 1 article in Instrumentalne Materialoznavstvo (Ukraine) (G8.33); 24 articles in Bulgarian magazines (G8.1, G8.2, G8.6, G8.7, G8.12 – G8.19, G8.24 – G8.26, G8.28 – G8.32, G8.35 – G8.37), 2 of which in English; 9 reports at conferences and congresses in Bulgaria (G8.3 – G8.5, G8.8 – G8.11, G8.20, G8.34).

Four of the publications from the G8 group are self-contained. As. Tatiana Mechkarova, PhD, is the first author in 12 scientific publications, and second author in 7, which confirms her leading role in the scientific works of group G8, whose asset corresponds to a total of 301.7 points.

► Group D, indicator 12: The attached reference for citations includes 18 citations in scientific publications, referenced and indexed in world-famous databases, which in numerical terms are equivalent to 180 points.

► Indicator Zh.29 of TU - Varna: The applicant's asset according to this indicator is based on the timetable of lecture courses held in the interval 2021 - 2023 and corresponds to 500 points, which many times exceeds the minimum requirements of TU - Varna.

The above confirms that the asset of As. Tatiana Mechkarova, PhD, in quantitative terms, significantly exceeds the minimum national requirements according to ZRASRB/2019 and those of TU - Varna for occupying the academic position "Associate Professor" in the field of the competition.

3. General characteristics of the candidate's research and scientific-applied activity

The scientific publications of As. Tatiana Mechkarova, PhD, are thematically oriented in two directions: 1). Study of the structure and properties of conventional metal alloys and composite materials with a polymer matrix (B4.1 – B4.11, G8.1–G8.5, G8,6 – G8.9, G8.14 – G8.17, G8. 19, G8.22, G8.25, G8.26 – G8.37); 2). Research and modeling of structural elements and technological processes (G8.10, G8.13, G8.16, G8.18, G8.20 – G8.24).

According to ZRASRB/2019, the scientific works of group B4 have a determining importance for the scientific research activity of the candidate. This group is dominated by publications related to finite-element and experimental studies of the welding process. The applicant's interest in the welding process is also confirmed by the presented document certifying qualification in welding Reg. No:1764-74/08.09.2023. Given the abstract nature of each finite element model, the need to assess its adequacy is indisputable. A reliable criterion for adequacy of the corresponding finite element model is the comparison between results obtained from numerical simulations and experiment. From this point of view, I positively evaluate the use of a combined research approach, including numerical simulations and experiments (for example publications B4.2 and B4.3). However, this approach is reliable if two conditions are met: 1). The finite element model is developed with realistic geometry,

interactions, boundary conditions and a constitutive model of the material in the elastic and plastic regions; 2). The quantitatively measurable parameters of the respective objects in the finite element model and the experiment are the same (at least the geometrical parameters). The second condition is clearly not met in publication B4.3. The welding process is characterized by huge temperature gradients due to the uneven heating and cooling of the material in and around the weld seam area, which can cause phase transformations of the main and additional material as a result of solid-liquid-solid transitions state, and in the center of the arc there is also evaporation of material. The two categories - displacements, resp. Stresses, and temperature field, strongly influence each other, i.e. a fully-coupled thermal-stress analysis is required.

Conductive heat exchange has a determining role, and the function of variation of the coefficient of conductive thermal conductivity for steel above 850 °C is unknown and represents a rough approximation. Therefore, at the current level of scientific development, numerical simulations of the welding process largely predetermine conditional results due to objective reasons – unknown parameters defining the heat flow distribution function, unknown physical material characteristics at higher temperatures, incorrect temperature-dependent constitutive models of the material in the presence of transitions solid – liquid – solid state. Apart from these arguments, the fact that temperature-dependent mechanical and physical characteristics up to 500 °C are defined in the weld zone, and up to 1000 °C in the base material (publication B4.3), is puzzling. In the context of the above, numerical simulations in a SolidWorks do not allow achieving an adequate scientific level. In the context of the mentioned arguments, the results of the experimental studies of the structure and properties in the scientific publications are more convincing.

As. Mechkarova's activity as a leader and participant in the implementation of research projects is impressive. The candidate was the manager of 9 internal scientific research projects (NIS). The attached reference for scientific and scientific-applied developments related to the development of laboratory 220 MF certifies that As. Mechkarova was the head of 4 more scientific research projects. In the period 2017 - 2023, the candidate participated in 12 scientific forums, two of which were organized abroad - Romania and Greece.

The convincing qualification of As. Mechkarova, PhD, as a designer is confirmed by the reference for additional employment contracts.

The activity of As. Tatiana Mechkarova, PhD in the publication, research and applied scientific activities convinces me that she has the necessary qualifications and expertise to hold the position of "Associate Professor" in the field of the competition.

4. Assessment of the candidate's pedagogical training and activity

As. Tatyana Mechkarova, PhD, has participated in the development of two study programs for the Bachelor's degree: 1) Processing of metals through plastic deformation; 2) Cutting and welding technology. In the period 2020 - 2023, the candidate led lectures in 5 disciplines and laboratory exercises in 7 disciplines in the "Bachelor" degree. As. Mechkarova, PhD was the supervisor of a total of 10 graduates who successfully defended their diplomas - respectively 5 in the "Bachelor's" and "Master's" courses.

An indisputable proof of the candidate's contribution to increasing the quality of the educational process is her participation in the modernization of the material base of the Department of Materials Science and Materials Technology at TU - Varna. As. Mechkarova, PhD, participated in the development of: 1) Laboratory "Structural analysis, filming and

research of technological objects"; 2) Laboratory for macro- and micro-metallographic analysis; 3) Research complex at the Student Marine Club.

As. Mechkarova, PhD, has visited 8 universities under the Erasmus program: the National Technical University of Athens; The Mediterranean Institute of Management in Cyprus; The University of Galați, Romania; University of Western Attica, Greece; The International Greek University of Thessaloniki; Ovidius University of Constanta, Romania; Naval Academy, Romania.

In addition to the welding certificate, a reference is presented regarding: 1) Full designer legal capacity - reg. number №16151, decision of the Board of KIIP 151/12.10.2018; 2) Professional qualification TEACHER in the specialty "Mechanical engineering and technologies", series C-00, No. 052527/reg. No. 291/15.11.2002; 3) Completed three-month course "Initial Training Center" in the period 01.03 - 05.05. 2012 in Donbas, State Specialized Enterprise, Chernobyl NPP; 4) Course "Increased danger", certificate No: 0158/12; 5) Course "Response in emergency situations", Certificate No: 0159/12.

The above confirms the convincing pedagogical preparation and qualification of As. Tatiana Mechkarova, PhD in the field of the competition and in engineering in general.

5. Contributions

I propose the following classification and formulation of the main contributions:

► Scientific – applied contributions

- *The effectiveness of a combined approach based on different modes of heat treatment and severe surface deformation to improve the mechanical characteristics and operational behavior of aluminum bronze with β -transformation has been established;*

- *S – N curves of monolithic and welded flat samples of ferritic-austenitic steel under conditions of high cycle fatigue with and without prior exposure to corrosion were obtained;*

- *The correlation between the composition of the matrix and the type of the reinforcing phase and the mechanical properties of composites with a polymer matrix has been established experimentally;*

- *Methods have been developed for study the structure and properties of engineering materials;*

- *Regression models obtained for the influence of the technological parameters of various processes on the structure and properties of engineering materials;*

- *Experimental results on the nature initiation and growth of fatigue crack in flat monolithic and welded specimens of ferritic-austenitic steel with and without prior exposure to corrosion.*

► Applied Contributions

- *Database on the structure and properties of welded components and materials with application for design and repair restoration of machines and equipment in the chemical, oil and gas industries;*

- *Composition and type of the reinforcing phase, ensuring optimal mechanical properties of composites with a polymer matrix for use in small-tonnage shipbuilding and the chemical industry;*

- *Stands for mechanical tests and laboratory installations for researching corrosion and stress corrosion of engineering materials have been developed;*

6. Significance of contributions to science and practice

Contributions can be used for the design and repair of machinery and equipment in the chemical, oil and gas industries, and small-tonnage shipbuilding.

7. Critical notes and recommendations

I have the following recommendations for the candidate:

- It is necessary to expand the application of numerical simulations in scientific research based on high-level CAE systems for engineering analysis (ABAQUS, ANSYS, etc.);
- In the context of the modernized laboratory base, it is appropriate to develop a textbook or teaching aids in the field of materials technology.

8. Personal impressions

Since I do not personally know As. Tatiana Mechkarova, PhD, my impressions are formed on the basis of the scientific production and the demonstrated activity in scientific research and scientific applied work. This gives me reason to believe that As. Tatiana Mechkarova, PhD, is hardworking, responsible and has the necessary qualifications to occupy the academic position of "Associate Professor" in the field of the competition.

9. Conclusion:

Based on the above, I propose that As. Tatyana Mitkova Mechkarova, PhD, be elected as an "Associate Professor" in field of higher education - 5. Technical sciences, professional direction - 5.1. Mechanical Engineering, study discipline "Materials Technology".

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Reviewer: /Prof. Galya V. Duncheva, DSc, PhD/