# OPINION

**from Assoc. Prof. Vladimir Petrov Todorov,**
**Technical University of Gabrovo, Department of Materials Science and Mechanics of Materials, Member of the Scientific Jury on materials submitted for participation in a competition**
**for the academic position of „Associate Professor“**
**in the field of higher education – 5. Technical Sciences**
**in the professional field – 5.6. Materials Science**
**specialty – Materials Science and Technology of Engineering Materials**

In the competition for Associate Professor, announced in the State Gazette No. 53/09.06.2026 and on the website of TU-Gabrovo, for the needs of the Department of „Mechanical Engineering, Computer Systems and Electrical Engineering“ at the Technical College of Lovech. The candidate participating in the competition is Senior Assistant Professor Eng. **Mariana Dimitrova Ichkova Ph.D.**, Technical University of Gabrovo.

## 1. Review of the content and results of the submitted works

The candidate, Chief. Assist. Prof. Mariana Dimitrova Ichkova, PhD, fully satisfies the minimum national requirements and the requirements of the Technical University of Gabrovo for occupying the academic position of "Associate Professor," as regulated by the Regulations for the Application of the Development of Academic Staff in the Republic of Bulgaria Act and the Regulations for Acquiring Academic Degrees and Occupying Academic Positions. The materials for participation in the competition are distributed into groups of indicators as follows:

- ✓ **Group A, indicator 1**: Abstract of a PhD thesis for the award of the educational and scientific degree "Doctor" on the topic: "Investigation of the Residual Macrostress Field Around Cold-Expanded Holes in Low and Medium Carbon Steens", Technical University of Gabrovo, 2008.
- ✓ **Group B, indicator 4**: Habilitation thesis - formed by 13 related scientific publications in international scientific journals with an Impact Factor, indexed by Web of Science, on the topic: "*Improvement of Surface Properties and Operational Behavior of Metallic Components via Surface Plastic Deformation (SPD) with Sliding Friction Contact*".
- ✓ **Group G, indicators 7 and 8:** A total of 21 scientific publications are presented, of which:
  - 2 under indicator 7 in international publications indexed in the global database Web of Science (WoS);
  - 2 under indicator 8 in peer-reviewed international publications;

- 17 under indicator 8 in peer-reviewed non-refereed publications.

*The total number of publications submitted for participation in the competition is 34, of which 19 are written in English. Four of the publications are single-authored, the candidate is the leading (first) author in 8, the second author in 9 publications, the third author in 3, and a fourth, fifth, or subsequent author in the remaining ones. Due to the absence of co-authorship share protocols, it can be assumed that the candidate has at least an equal contribution to the submitted co-authored works.*

- ✓ **Group D:** The submitted list of citations of scientific works includes a total of 148 citations in publications refereed and indexed in SCOPUS.
- ✓ 2 textbooks and 1 study guide in co-authorship, as follows:
  - Computer Methods for Engineering Analysis, Book 1: Linear Statics of Beam Structures, Gabrovo, 2014, ExPres;
  - Specialized (Non-standard) Processing Methods and Tools, Gabrovo, 2018, ExPres;
  - Specialized (Non-standard) Processing Methods and Tools – Syllabus and Test Questions, Gabrovo, 2019, ExPres.

**Conclusion** - according to the submitted reference sheet, the candidate covers the minimum national requirements in accordance with the Development of Academic Staff in the Republic of Bulgaria Act, as well as the additional requirements of the Technical University of Gabrovo for occupying the academic position of "Associate Professor," with the requirements for some of the indicators being exceeded multiple times - groups B and D.

**2. General characteristics of the candidate's activities**

**2.1. Educational and pedagogical activity**

According to the attached reference sheets, Chief. Assist. Prof. Mariana Ichkova, PhD, began her professional career at the Technical University of Gabrovo in 2008 as an Assistant Professor in the Department of Technical Mechanics. In 2009, she successfully defended her PhD thesis in professional field 5.1. "Mechanical Engineering", under the "Applied Mechanics" doctoral program, after which she took up the academic position of "Chief Assistant Professor".

In the course of her teaching activities, the candidate delivers lectures in one discipline and conducts laboratory and seminar classes in eleven disciplines included in the academic programs of majors for the "Bachelor" and "Master" educational and qualification degrees, in both full-time and part-time forms of education at the Faculty of Mechanical and Precision Engineering and the Faculty of Electrical Engineering and Electronics of the Technical University of Gabrovo.

**Discipline in which lectures were delivered:**

- Technical Mechanics

**Disciplines in which laboratory and seminar classes were conducted:**

- Materials Science and Technology of Engineering Materials
- Computer Methods for Engineering Analysis
- Strength of Materials
- Mechanics of Materials
- Applied Mechanics
- Mechanics I
- Mechanics II
- Mechanics
- Technical Mechanics
- Theoretical Mechanics
- Kinetics of Rigid Bodies.

The data on the candidate's teaching workload over the last three academic years show 731.1 hours for 2023/2024, 644.1 hours for 2024/2025, and 615.3 hours for 2025/2026, respectively. The specified values significantly exceed the established baseline requirement of 430 hours, which demonstrates a high teaching workload and active engagement with the educational process.

**2.2. Scientific and Applied Scientific Activities**

The scientific and applied scientific activities of Chief. Assist. Prof. Mariana Ichkova, PhD., are focused on the investigation of surface plastic deformation processes, enhancing the fatigue life of structural elements, and developing experimental and simulation models for analyzing the mechanical behavior of metals and alloys. In the scientific works submitted for participation in the competition, three main thematic areas stand out: *(1) improvement of surface properties and operational behavior of metallic components via surface plastic deformation (SPD); (2) development and investigation of technological methods for increasing the fatigue life of structural elements with fastener holes; (3) experimental and simulation investigation of the mechanical characteristics and behavior of metals and alloys*.

In the first area, the scientific research is focused on the possibilities for controlling and improving the surface layer characteristics through surface plastic deformation, specifically via diamond slide burnishing (Slide Burnishing – SB). The influence of main technological parameters on the roughness, microhardness, residual stresses, microstructure, and fatigue life of various types of carbon and alloy steels and non-ferrous alloys has been investigated. A significant aspect of the research is establishing the relationships between the technological parameters, the formed surface layer characteristics, and the operational behavior of the processed components. The influence of technological heredity on the formation of the final characteristics of the surface layer during surface plastic deformation has been

investigated, analyzing the relationships between previous technological operations, processing conditions, and the resulting surface state.

To solve the formulated scientific problems, methods of experimental design, regression and analysis of variance (ANOVA), as well as numerical modeling using the finite element method (FEM) were applied. Fatigue life prediction models were developed and thermomechanical simulations were conducted, the results of which were compared with experimental data, including residual stress measurements via X-ray diffraction (XRD). Of particular interest is the analysis of the dual-phase microstructure formed in the surface layer of austenitic steels due to deformation-induced martensitic transformation, as well as the proposed approach for determining the effective surface residual stress.

The second area is related to the development and numerical investigation of technological methods for increasing the fatigue life of structural elements with fastener holes. Various options of surface plastic deformation have been considered, including ball burnishing (mandreling), conventional cold expansion, and the StressWave method. Through three-dimensional finite element models, the formation and redistribution of residual compressive stresses have been analyzed, as well as the influence of the geometric parameters of the tools on the stress state and the required axial force. Particular attention has been paid to structural elements with holes of complex (non-circular) geometry. Based on numerical simulations and experimental investigations, solutions have been proposed to increase the fatigue strength and reliability of the elements, and regression models have been developed to assess the degree of strain hardening around the processed holes.

The third area encompasses the experimental and simulation investigation of the mechanical characteristics and behavior of metals and alloys under various loading conditions. Based on conducted mechanical tests, constitutive models with isotropic, linear, and non-linear kinematic hardening have been developed, describing the behavior of materials under cyclic deformation. The models have been applied in the numerical investigation of residual stress relaxation around cold-expanded holes. Within this area, the stress concentration in structural elements made of various steels and the influence of geometric and material parameters on it have been investigated. Regression relationships have been developed to estimate the stress concentration factor depending on the respective parameters. The influence of testing temperature, heat treatment regimes, and alloying elements on the mechanical characteristics of tool steels designed for operation at elevated temperatures has also been investigated.

The scientific and applied nature of the research is demonstrated in the development of mathematical and finite element models of technological processes and mechanical systems, in establishing relationships between control factors and the resulting characteristics of the processed surfaces, as well as in creating a

database with optimal parameter values for surface plastic deformation processes. These values are aimed at achieving minimal roughness, increased microhardness, and favorable residual compressive stresses. The creation of technological tooling for implementing surface plastic deformation processes is also indicated as an applied result.

The candidate's research activity also includes participation in the implementation of research projects. Chief. Assist. Prof. Mariana Ichkova, PhD., has participated in three national research projects funded under European programs, as well as in 18 projects funded by the national budget, with the Technical University of Gabrovo as the beneficiary. The participation in these projects complements the characterization of her scientific and applied scientific activities and demonstrates her commitment to the realization of research tasks.

In summary, the submitted works characterize the scientific and applied scientific activities of the candidate with consistency in research pursuits and the development of scientific research in the field of materials science and Surface Engineering (SE). Combining experimental research with mathematical and numerical modeling contributes to deepening the knowledge regarding hardening mechanisms, the formation of surface properties, and residual stresses during plastic deformation. The obtained results create prerequisites for deepening the knowledge and improving the approaches for predicting the behavior of metallic structural elements, as well as for developing engineering solutions aimed at increasing their operational reliability, fatigue life, and efficiency.

**2.3. Innovation and Implementation Activities**

In the submitted documents for participation in the competition for occupying the academic position of Associate Professor, there are no data regarding innovation and implementation activities by the candidate.

**3. Contributions. Significance of the Contributions for Science and Practice**

The scientific works submitted by Chief. Assist. Prof. Mariana Ichkova, PhD, contain applied scientific and applied contributions related to the development of methods for surface plastic deformation (SPD), the modeling of technological processes, and the investigation of the mechanical behavior of metals and alloys. The contributions are aimed at establishing patterns, developing mathematical and finite element models, and creating technological solutions for improving the surface properties and operational behavior of metallic components. You can continue with the translation of the specific subsections and contributions.

***The applied scientific contributions*** are demonstrated in the development of finite element models of metalworking processes and mechanical systems, as well as mathematical models for describing and predicting the geometric and mechanical

characteristics of the surface layer during SPD. Relationships have been established between the technological parameters, the formed surface properties, and the operational behavior of the processed components. The influence of technological heredity on the efficiency of surface plastic deformation has been investigated, as well as the relationship between technological parameters and the formation of deformation-induced α'-martensite during the processing of chromium-nickel austenitic steels.

A significant contribution is the development of mathematical models for describing the strain hardening and creep of the material around cold-expanded holes, as well as models for the energy and force characteristics of SPD processes. The energy balance in the thermodynamic system "deforming element - processed surface" during diamond slide burnishing has been investigated. Models for the strain hardening of tough-plastic alloys and for describing the mechanical characteristics of die steels have also been developed. The contributions also include the developed classification schemes of methods and processes for SPD, as well as the combined, hybrid, and environmentally friendly technological approaches for improving the surface properties of metallic components.

***The applied contributions*** are related to the practical utilization of the obtained results in the selection and optimization of technological regimes for surface plastic deformation. A database has been created with optimal values of the control factors that ensure minimal roughness, maximum microhardness, and favorable residual compressive stresses in the surface layer. Technological tooling for implementing SPD processes has also been developed, which creates prerequisites for the practical application of the investigated methods.

The significance of the contributions for science and practice is determined by the possibilities for a deeper elucidation of the mechanisms of strain hardening and residual stress formation, as well as for predicting the behavior of metallic components under operational loading. The developed models and established relationships support the selection of technological parameters and the improvement of metal surface processing operations. Their practical orientation is related to improving the quality of the surface layer and creating prerequisites for increasing the fatigue life, reliability, and operational efficiency of structural elements.

As an additional applied activity, the participation of the candidate in the maintenance and modernization of the material and technical base of the Technical University of Gabrovo should be noted, as well as the work of the candidate in the "Metal Testing" laboratory, and her activities in the technical editing of a scientific journal and the preparation of university entrance tests. These activities complement the characterization of the professional activity of the candidate and are of importance for ensuring both the educational and the research processes.

**4. Assessment of the personal contribution of the candidate**

The personal contribution of Chief. Assist. Prof. Mariana Ichkova, PhD, in the submitted scientific works is indisputable, as she is a sole or leading author in one-third of the total number of publications. In the remaining co-authored works, the candidate has at least an equal contribution. The authorship in the textbooks and the active project activity of the candidate additionally prove her personal and significant contribution to the development of the scientific and teaching activities in the field.

**5. Critical notes and recommendations**

The following recommendations are applied for the candidate, which in no way diminishes the statements written above:

1. In view of the accumulated serious scientific experience (148 citations in Scopus and numerous projects), it is recommended that Chief. Assist. Prof. Mariana Ichkova, PhD, actively engage in the academic supervision of diploma students and doctoral students subsequently, with the aim of expanding the research activity in the department;
2. To continue the trend of publishing scientific works in world-renowned referred and indexed journals.

**6. Personal impressions**

I know Chief. Assist. Prof. Mariana Ichkova, PhD, personally as a colleague from the Department of Materials Science and Mechanics of Materials. In the framework of our joint work, I have become convinced of the responsibility, organizational skills, and dedication demonstrated by her in both teaching and research activities. She possesses good communication skills, knows how to work effectively in a team, and displays precision and consistency in the performance of the professional duties assigned to her. My direct impressions provide grounds to consider that the professional and personal qualities of the candidate meet the requirements for occupying the academic position of "Associate Professor".

**7. Conclusion**

**Taking into account the above, I propose that Chief Assistant Professor Mariana Dimitrova Ichkova, PhD, Eng., be elected to the academic position of "Associate Professor" in the field of higher education 5. Technical Sciences, professional field 5.6. Materials and Materials Science, specialty: "Materials Science and Technology of Engineering Materials".**

26.10.2026 Member of the Scientific Jury: …….

/Assoc. Prof. V. Todorov, PhD, Eng./