REVIEW

By Prof. Eng. Stoyko Atanasov Gyurov, PhD from the Institute of Metal Science, Equipment and Technologies with the Center for Hydro- and Aerodynamics “Acad. Angel Balevski”, Bulgarian Academy of Sciences (IMSETHC-BAS) according to the materials submitted for participation in a competition for the academic position of "Professor" in the field of higher education 5. Technical sciences, professional direction 5.6. Materials and materials science, specialty "Materials science and technology of engineering materials". In the competition for a professor, announced in the State Gazette, no. 47/24.06.2022 and on the TU-Gabrovo website for the needs of the "Materials Science and Mechanics of Materials" department at the "Mechanical Engineering and Instrumentation" faculty, one candidate participated - Associate professor Eng. Angel Petrov Anchev, PhD.

1. Brief biographical data

Associate Professor Eng. Angel Petrov Anchev, PhD, completed his secondary education in 1995 at the Technical School of Electrical Engineering "M. V. Lomonosov" G. Oryahovitsa with a specialty "Industrial electronics - computing technology". In 2000, he received a Master's degree, majoring in "Engineering and Technologies for the Protection of the Natural Environment" at the Technical University Gabrovo. In 2005, the candidate obtained the educational and scientific degree "Doctor", in the scientific specialty "Applied Mechanics" with the topic of the dissertation "Increasing the load-bearing capacity and fatigue durability of structural elements with cylindrical holes by means of spherical boring" at the Technical University Gabrovo. From 2004 to 2005, the candidate was an assistant in the Department of Chemistry and Ecology, Faculty of Economics, Technical University Gabrovo. From 2005 to 2011, he was Ch. assistant professor in the same department. From 2011 to 2016, he was the Ch. assistant professor in the Department of "Technical Mechanics", Faculty of "Mechanical Engineering and Instrumentation" of the Technical University Gabrovo. In 2016, he acquired the academic position of Associate Professor in the Department of Materials Science, Mechanics of Materials, Faculty of Mechanical Engineering and Instrumentation at the Technical University of Gabrovo, where he works until today.

The applicant's education and professional experience are in engineering specialties. The dissertation and the habilitation for "Docent" are within the scope (nomenclature) of the competition.

2. General description of the presented materials

Associate Professor Eng. Anchev, PhD has presented lists of all his works, which include 98 (ninety-eight) publications and 10 (ten) textbooks and study aids. Sixteen publications on the dissertation work, 45 (forty-five) publications and 6 (six) textbooks and study aids on the competition for associate professor I do not review.

The following are presented for the competition: a list of 38 (thirty-eight) publications, of which 5 are independent and 21 with an IF (WoS); a list of four textbooks and study aids; a list of

165 (one hundred and sixty-five) citations; a list of 8 (eight) projects; a list of two supervised PhD students; and a list of 28 supervised graduates. The requirements of TU Gabrovo for holding the academic position "Professor" are: total number of publications 30, of which at least 5 independent and 3 with IF (WoS); 20 citations; 3 textbooks; 1 successfully defended doctoral student and management of 3 projects and contracts.

According to the criteria of Act on Development of the Academic Staff in the Republic of Bulgaria, the works are distributed as follows:

Criterion A: Indicator 1 - Dissertation work for awarding the educational and scientific degree "Doctor" - 1 issue, 50 points;

Criterion C: Indicator 4 - Habilitation thesis - 10 scientific publications in journals that are referenced and indexed in world-famous databases with scientific information - 127.14 points out of the required 100;

Criterion D: Sum of indicators 7 and 8 – 270.78 points out of required 150;

Criterion D: Sum of indicators 12 and 14 – 1594 points with required 80;

Criterion E: Sum of indicators 17, 18, 20, 22-24 – 170.66 points out of required 120.

The works presented in the competition meet and exceed the minimum requirements of the Act on Development of the Academic Staff in the Republic of Bulgaria and the requirements of TU Gabrovo.

3. Habilitation work - scientific publications (not less than 10) in publications that are referenced and indexed in world-famous databases with scientific information

The habilitation work includes 10 publications, 1B1-1B10 from the list of publications under the competition. Thematically, they are related and address issues of improving the performance behaviour of metallic materials by managing Surface Integrity (SI) properties. The conducted studies are to a significant extent natural experiments based on pre-planning and planning of the experiment, and modern methods were used to evaluate the obtained SI characteristics - 3D optical profilometry, scanning electron microscopy (SEM), energy-dispersive X-ray spectroscopy (EDX), X-ray structural analysis, as well as mechanical tests of one-dimensional tensile, cyclic rotational bending, microhardness and roughness measurements. Characteristics were investigated obtained as a result of the mechanical processing of the surface such as topography, texture, roughness, microstructure, residual stresses, surface hardness and its distribution in depth from the processed surface. Publications presented as equivalent to a monographic work have been cited in international journals with IF 34 times.

4. Reflection of the candidate's scientific publications in the scientific community

The works of Assoc. Prof. Eng. Angel Petrov Anchev, PhD are widely popularized around the world and are followed with great interest. In Scopus, after removing the self-citations of all authors, Prof. Anchev is visible with 185 citations and an h-index of 7. The papers in the competition were cited 131 times.

5. Overview of the content and results in the presented works

The candidate's scientific works address the following issues:

1) Improvement of the characteristics of Surface Integrity, wear resistance, fatigue behaviour and roughness after surface treatment with diamond smoothing of structural elements from single-phase and two-phase aluminium bronze [1.B.1, 1.B.2., 1.B.3, 1.B.4, 4.G.11, 4.G.12, 4.G.13, 4.G.14]; aluminium alloy 2024-T3 [1.D.1, 3.D.1, 4.D.1, 4.D.2]; austenitic chromium-nickel steel AISI 304L [1.B.7, 4.D.15]; low-alloy carbon steel 41Cr4 [1.D.4, 1.D.6] and steels S235, 45 and Y8A [4.D.8].

Researches are related to surface treatment processes by means of diamond polishing of various metal components in order to increase their fatigue strength, and their fatigue life, in correlation with Surface Integrity. New optimization procedures of static processes for surface plastic deformation are proposed.

2) Overview of diamond polishing methods [1.B.10].

A review article devoted to the diamond smoothing of structural elements. The literary sources were analysed according to various criteria and graphical visualizations of the statistical results were made. On this basis, relevant conclusions are drawn and directions for future research on the subject are outlined.

3) A new constitutive model of the surface material and subsurface layers and conditions for reaching a stabilized cycle, to evaluate the fatigue behaviour of test specimens of low-alloy structural steel 37Cr4 machined by means of diamond polishing [1.B.8, 1.B.9].

The adequacy of the proposed model and approach to reach a stabilized cycle has been proven through rotational bending fatigue tests, experimental measurement of residual stresses and the resulting microstructure of the surface layer.

4) Improvement of the characteristics of Surface Integrity and fatigue behaviour of structural elements of high-strength aluminium alloy 2024-T3 by means of surface plastic deformation with a toroidal roller [1.D.8, 1.D.9, 4.D.5, 4.D .6, 4.D.9, 4.D.10].

Regression analyses and a planned numerical experiment were conducted based on a specially developed 3D FE (finite element) model, and models of the maximum equivalent plastic strain, the depth of the plastically deformed zone, and the circumferential and axial residual stress field were obtained. A multi-objective optimization was performed to determine the geometric parameters and the pressing force of the toroidal roller.

5) Comparative study between the processes diamond smoothing, surface plastic deformation with a toroidal roll and deep rolling on the parameters of Surface Integrity (microhardness, microstructure, residual stresses, roughness) and fatigue behaviour of low-alloy carbon steel specimens [1.B.6, 4.D.7].

Comparative results and analysis of the results of experiments and thermomechanical analysis by the FE (finite element) method of three static processes realizing polishing methods are presented: diamond-polishing, roller polishing and deep rolling.

6) Optimization procedure for increasing the fatigue strength, microhardness and depth of the hardened layer, as a function of the radius of the tip of the tool and the pressing force of test

specimens of low-alloy carbon steel 41Cr4 [1.B.5].

An optimization approach is proposed to increase the fatigue strength of steel specimens based on the idea that the fatigue strength can be controlled by the SI characteristics.

7) Investigation of the characteristics of welded, by means of electron beam welding, joints of pure copper and austenitic chrome-nickel steel AISI 30L [1.D.11, 2.D.1].

The chemical and phase composition, microstructure and mechanical properties of the welded joints were determined.

8) Increasing the crack resistance of holes in joint connections, by means of surface plastic deformation [1.D.2].

The article presents a new technology for processing holes in guide rail ties.

9) An approach to improve the fatigue behaviour of fastener holes in structural elements of aluminium alloy 2024-T3 by means of surface plastic deformation with a K-profile tool [1.D.3, 4.D.3, 4.D.4].

A new method and tool is proposed for processing a large number of small fastener holes in high-strength Al alloy by cold plastic deformation. Experiments were conducted to determine the optimal values of the technological parameters of the process.

10) Comparative analysis of methods for expansion of fastener holes in D16AT aluminium alloy, based on KE models, fatigue tests and microstructure and evaluation of fatigue durability [1.D.5].

Friction stir hole expansion (FSHE), solid mandrel cold working and symmetric cold expansion (SCE) methods for hole expansion in Al-alloy D16AT used in the aerospace industry are evaluated. The results are summarized based on conducted fatigue tests, X-ray diffractometry and microstructural analysis.

6. General description of the applicant's activity

6.1. Educational and pedagogical activity

Associate professor Eng. Angel Petrov Anchev, PhD is the head of the "Materials Science and Mechanics of Materials" department at Gabrovo Technical University.

The candidate has led lectures on the academic disciplines: "Technologies for layered construction"; "Digital Prototyping"; "Technical mechanic"; "Mechanics I"; "Mechanics II"; "Computer Simulations of Systems and Processes". He has developed lecture materials for the following academic disciplines: "Technologies for layered construction"; "Information collection and processing systems"; "Computer Simulations of Systems and Processes".

The candidate has supervised two PhD students who successfully defended their degrees: M.Sc. Eng. Tihomir Petrov Atanasov, diploma № 0088/18.09.2020 and M.Sc. Engineer Desislava Krasimirova Kovacheva, diploma № 0099/13.07.2022 and 28 (twenty-eight) successfully defended graduates.

Associate Professor Anchev is the author or co-author of 10 (ten textbooks and teaching aids), four of which are presented in the materials of the current competition.

The above-mentioned data give me reason to evaluate the candidate's educational and

pedagogical activity as very good.

6.2. Scientific and scientific-applied activity

The results of the candidate's scientific activity are popularized mainly through their publication in journals, referenced and indexed in world-renowned databases.

Associate Professor Anchev has participated in 6 (six) scientific projects specifically financed by the State Budget and in one project under the "Science and Education for Intelligent Growth" program. Team leader of the partner organization in Project KP-06-H47/6-26.11.2020 "Investigation of processes and structural changes during electron beam welding of metals and alloys with different thermophysical properties". The budget of the Project for TU-Gabrovo is BGN 60,000.

6.3. Implementation activity

I don't find any data on implementations in the competition materials.

7. Contributions (scientific, scientific-applied, applied)

7.1 Scientific

7.1.1 For the first time, the hypothesis was substantiated and experimentally proven that materials that are strengthened under the action of cyclic deformation impact reach maximum values of the fatigue limit when the surface layer reaches a stabilized cycle [1.B.8, 1.B.9].

7.1.2 The correlations between different combinations of process parameters for the surface plastic deformation with the main characteristics of SI, fatigue life and fatigue limit have been established, which allows by means of SI control to manage and predict the fatigue behaviour and wear resistance of the material [1. B.1-1.B.4, 1.B.7, 1.G.1, 1.G.4, 1.G.6, 3.G.1, 4.G.1, 4.G. 2, 4.G.8, 4.G.11-4.G.15].

7.1.3 New optimization procedures and mathematical models have been developed of the behaviour of the surface layers of structural materials subjected to plastic deformation with different methods [1.B.1, 1.B.5, 1.B.6., 1.B .9, 1.G.4, 1.G.6., 1.G.10, 4.G.5, 4.G.6, 4.G.9].

7.1.4. A regression mathematical model was developed of the sliding friction coefficient between the diamond tip and the processed bronze alloy surface at different sliding speeds [4.D.14].

7.1.5. It has been proven that the introduced useful residual compressive stresses in the surface and subsurface layers of structural elements increase their fatigue life [1.D.1, 1.D.3].

7.1.6. It has been proven that fatigue cracks form at the boundary between the affected surface layer and the base material [1.D.1].

7.1.7. An integrated classification of static methods for surface treatment was created and the field of application of diamond smoothing was outlined [1.B.10].

7.2 Scientific and applied

7.2.1. The method of diamond smoothing of test bodies made of aluminium bronze has been optimized, which leads to an increase in the fatigue strength and wear resistance of the material [1.B.1-1.B.4, 4.D.11-4.D.14].

7.2.2. A methodology has been developed for determining the technological parameters of the diamond smoothing process, with the aim of obtaining minimum roughness (4.D.8).

7.2.3. Surface integrity parameters and the fatigue behaviour of steel test specimens subjected to diamond smoothing, roller smoothing and deep rolling were established [1.B.6, 1.B.7, 4.D.7].

7.2.4 Models of the maximum equivalent plastic deformation, the depth of the plastically deformed zone and the field of residual circumferential and axial stresses in high-strength aluminium alloy 2024-T3 were developed. The optimal geometric parameters and the pressing force of the toroidal roller were determined [1.G7, 1.G.8, 1.G.9, 4.G.5, 4.G.6, 4.G.9, 4.G.10].

7.2.5. The optimal technological parameters have been established of the process of electron beam welding of Cu and chromium nickel austenitic steel 304l [1.D.11, 2.D.1].

7.2.6 The technological parameters for surface plastic deformation have been established of aluminium bronze holes leading to improved characteristics of SI [1.B.1].

7.2.7 The influence of technological parameters of the diamond smoothing process on the microhardness and roughness of samples made of aluminium alloy D16T was established [3. D.1, 4.D.1].

7.2.8 The optimal technological parameters have been established of the surface plastic deformation of small holes using a K-profile tool [4.D.3, 4.D.4].

7.2.9 The technological parameters are determined of diamond smoothing of austenitic chromium nickel steel AISI 304 with a view to obtaining maximum microhardness [4.D.15].

7.3 Application Contributions

7.3.1 Optimum values of the technological parameters have been established of the processes of cutting and diamond smoothing of holes in connections for guide railway rails [1.D.2].

7.3.2 The effectiveness of a new method and a specially designed, profiled tool has been proven for processing a large number of small fastener holes in structures made of high-strength Al alloys by cold plastic deformation [1.D.3, 4.D.3, 4.D.4].

7.3.3. A tool implementing the method of surface plastic deformation with a toroidal roller for processing external cylindrical surfaces was designed and manufactured [1.D.8, 1.D.9].

7.3.4 7.3.4 Fatigue curves and fatigue limit data were obtained for the high-strength aluminum alloy 2024-T3 [1.D.9] and steel 41Cr4 [1.B.6], under different combinations of surface plastic deformation with a toroidal roller.

7.3.5 Fatigue curves and data on the fatigue limit were obtained of high-strength aluminium alloy 2024-T3 [1.Г.1], steel 37Cr4 [1.B.8], single-phase aluminium bronze CuAl8Fe3 [1.B.3] and two-phase aluminium bronze CuAl9Fe4 [4.D.12] after diamond polishing.

8. Evaluation of the candidate's personal contribution

Publications in Scopus-refereed publications (twenty-one in number for the competition) are subject to a plagiarism check. In the other works, the same scientific problems are developed, so I have no doubts about the candidate's personal contribution in the works presented for the competition.

9. Critical notes and recommendations

I have no critical notes and recommendations that cast doubt on the applicant's scientific and

scientific-applied contributions. It is surprising to me that with such valuable results in scientific works there are no applied contributions or patents!

10. Personal impressions

I have no personal impressions of the candidate.

11. Conclusion:

Bearing in mind the above, I propose that Associate Professor Eng. Angel Petrov Anchev, Ph.D., be elected "Professor" in the field of higher education 5. Technical sciences, professional direction 5.6. Materials and materials science, specialty "Materials science and technology of engineering materials" for the needs of the department "Materials science and mechanics of materials" at the faculty of "Mechanical engineering and device engineering".

01.11.2022 Reviewer: /signature/

/Prof. Eng. Stoyko Gyurov, PhD/