REVIEW

of the scientific writings submitted in a competition for an academic position "Professor" in the field of higher education 5. Technical sciences, professional field 5.6. Materials and materials science, scientific specialty "Materials science and technology of machine-building materials", announced by the Medical University "Prof. Dr. Paraskev Stoyanov" Varna in the State Gazette issue 53 of 12.06.2020 with an only candidate Assoc. Prof. DSc Eng. Tsanka Dimitrova Dikova.

Reviewer: Prof. PhD Eng. Stoyko Atanasov Gyurov from the Institute of Metal Science, equipment, and technologies with Center for Hydro- and Aerodynamics "Acad. A. Balevski" at the Bulgarian Academy of Sciences.

The report is based on: Order № P-109-290/07.08.2020 of the Rector of the Medical University "Prof. Dr. Paraskev Stoyanov" Varna for appointment of a scientific jury, according to a decision of the faculty council of the Faculty of "Dental Medicine" under Protocol № 27/04.08.2020, and decision of the scientific jury for selection of reviewers (Protocol of the first meeting of the scientific jury from 17.08.2020).

1. Brief biographical data about the candidate

Assoc. Prof. DSc Eng. Tsanka Dimitrova Dikova graduated higher education in 1984 at the Technical University of Varna with a professional qualification "Master of Engineering" with a degree in "Technology of Mechanical Engineering and Metal Cutting Machines". In 2005 she defended her dissertation for the acquisition of educational and scientific degree "Doctor" on "Study of the behaviour of steels 5ChNM, 3Ch2V8F и 4Ch5MFS under laser treatment and thermocycling" in a Specialized Scientific Council at the Higher Attestation Commission of Republic of Bulgaria. In 2019 she successfully defended a dissertation on "Properties of additively manufactured dental materials" and obtained the scientific degree "Doctor of Science" in the professional field 5.6. Materials and materials science.

Assoc. Prof. Dikova specialized in: St. Petersburg State Marine Technical University, St. Petersburg, Russia in the Department of Materials Science in 2000; Tokai University, Japan in the Departments of Physics and Materials Science in 2005-2006; Rice University, Houston, USA with a Fulbright Scholarship in the Department of Mechanical Engineering and Materials Science in 2011-2012; Tokai University, Japan with a scholarship from the Ministry of Education and Science of Bulgaria at the Institute of Innovative Science and Technology 2017-2018.

The professional career of the candidate began in 1984 in "TEREM-Ivaylo", Veliko Tarnovo, as a designer-technologist. In 1997 she became chief designer at Metal Expert Peev & Co. From 2004 to 2006 she worked in the High-Tech Park of the Technical University of Varna, as a research engineer. Since 2007 she has been an Associate Professor in Materials Science and Technology of Machine-Building Materials at the Medical University "Prof. Dr.

P. Stoyanov" Varna, Faculty of "Dental Medicine". From 2013 to 2018 she has been "Deputy Dean" of the Faculty of "Dental Medicine".

2. General description of the submitted materials

Assoc. Prof. Dikova has presented lists of all her publications, which include four monographs, four textbooks, two book chapters, and 118 articles. For the competition, a list of twenty-nine writings I-G-7-(1-9) and I-G-8-(1-12) is presented, covering the minimum requirements of Low on Development of the Academic Staff in the Republic of Bulgaria, The Implementing Regulations to the Low and the requirements of the Medical University "Prof. Dr. Paraskev Stoyanov" Varna for holding an academic position "Professor ", plus a list of forty scientific papers II-A- (1-19) and II-B- (1-21) outside the minimum requirements, all that I review. I do not review the scientific papers on PhD dissertation, on dissertation for "Doctor of Sciences" and the previous habilitation, which I will take into account in the final evaluation. The works meeting the minimum requirements are divided by criteria as follows:

Criterion A

INDICATOR 1. Dissertation work for awarding educational and scientific degree „Doctor" - **1** issue.

Criterion B

INDICATOR 2. Dissertation work for awarding the scientific degree "Doctor of Science" - **1** issue.

Criterion V

INDICATOR 3. Published habilitation thesis - monograph - **1** issue.

Criterion G

INDICATOR 5. Published monograph, which is not presented as the main habilitation work - **1** issue.

INDICATOR 7. Publications in scientific journals referenced and indexed in world-famous databases with scientific information (Web of Science and Scopus) - **9** pcs.

INDICATOR 8. Publications in journals with scientific review, not referenced in world-famous databases with scientific information - **12** issues.

Criterion E

INDICATOR 23. Published university textbook - **4** copies, of which **2** in Bulgarian and **2** in English.

In the list of papers outside the minimum requirements, **11** are in scientific journals, referenced and indexed in world-famous databases with scientific information (Web of Science, Scopus), and **29** are in journals with scientific review, not referenced in world-famous databases with scientific information. Of the total of **69** scientific papers mentioned in the two lists, **18** are independent works of Assoc. Prof. Dikova. In **20** papers, she is the first author, and in **24** she is the second author.

The works of Assoc. Prof. Dikova are popularized around the world and are followed with interest. As of 01.08.2020, they are cited 196 times in scientific journals, monographs and collective volumes, referenced and indexed in world-famous databases (Web of Science,

Scopus), as well as in unreferenced journals. As evidence, covering the minimum scientometric requirements for holding an academic position "Professor", **34** of them were used for this competition according to Academic reference № 21 (335 / 13.07.2020). The citations in scientific journals, referenced and indexed in world-famous databases with scientific information are **14** (Web of Science, Scopus), the citations in monographs and collective volumes with scientific review are **3** and **17** are the citations in non-refereed journals with scientific review. The individual h-index of the author is **8** according to Google Scholar, **4** according to Research Gate and **4** according to Scopus.

Assoc. Prof. Dikova has given **8** lectures at foreign universities, and she has been invited to **13** scientific events as a lecturer. Since 2016 until now she is deputy editor-in-chief of the „Journal of Achievements in Materials and Manufacturing Engineering" and the „Archives of Materials Science and Engineering". From 2014 to 2018 she is deputy editor-in-chief of the journal „Scripta Scientifica Medicinae Dentalis", and since 2015 she has been the scientific secretary of the international journal „Materials Science: Non-Equilibrium Phase Transformations".

Assoc. Prof. Dikova has taken an active part in the development and implementation of two international research projects and three Bulgarian ones.

The candidate significantly exceeds the minimum requirements of the Low on Development of the Academic Staff in the Republic of Bulgaria, The Implementing Regulations to the Low and the requirements of the Medical University "Prof. Dr. Paraskev Stoyanov" Varna for holding the academic position "Professor".

I have no information about plagiarism in the writings of Assoc. Prof. Dikova.

3. General characteristics of the research, scientifically applied, applied and pedagogical activity of the candidate

3.1 Research, applied science and applied activity of the candidate

The object of research in the works of the candidate are: 1) problems of materials science regarding the connections between chemical composition - structure - properties of basic groups of materials - alloys, plastics, composites and ceramics with application in dental medicine and mechanical engineering; 2) technological problems in the implementation of modern processes, equipment and technologies in dental laboratory, dental medicine and machine building; 3) problems related to the behaviour of the studied objects in the conditions of different types of influences - chemical, thermal and mechanical in typical environments of operation.

The scientific papers can be grouped in six thematic areas as follows:

1) Application of 3D printing technologies - stereolithography with laser and light projection, fused deposition modelling and selective laser melting in dental medicine (I-B-2, I-B-3, I-D-7-1, I-D -7-2, I-G-7-3, I-G-7-4, I-G-7-5, I-G-7-6, I-G-8-1, II-A-15 , II-A-18, II-A-19, II-B-13, II-B-14, II-B-16, and II-B-21).

2) Nanomaterials in mechanical engineering, general and dental medicine, nano-engineered coatings on titanium with biomedical application (I-G-8-2, I-G-8-3, I-G-8-4, I-G-8 -5, I-G-8-6, I-G-8-7, II-A-10, II-A-11, II-B-1, II-B-2, II-B-3, II -B-4, and II-B-5).

3) Apparatus, technologies and dental materials - cements, composites, ceramics for direct and indirect restoration of defects of teeth and dentitions (I-G-7-7, I-G-7-8, I-G-7-9, I-G-8-10, I-G-8-11, I-G-8-12, II-B-9, II-B-18, and II-B-19).

4) Unconventional and surface heat treatments of alloys with concentrated energy fluxes - laser, plasma, electron beam (I-A-1, II-A-1, II-A-2, II-A-3, II-A-4, II -A-6, II-A-9, II-A-13, II-A-16, II-A-17, II-B-7, II-B-8, II-B-20, II-A -5, and II-B-6).

5) Corrosion processes in stainless, heat-resistant and tool steels with application in dental medicine and mechanical engineering (I-G-8-8, I-G-8-9, II-A-7, II-A-8, II-A-12, II-A-14, and II-B-12).

6) Design and application of modern software in mechanical engineering, digitalization in dentistry and education, educational literature (I-G-5-1, II-B-10, II-B-11, II-B-15, II-B-17, I-E-23-1, I-E-23-2, I-E-23-3, and I-E-23-3).

The topic of the scientific writings coincides with the topic (nomenclature) of the competition.

The scientific and applied activity of the candidate is related to projects, 31 in number, implemented in the company "Mauer Locking Systems" Ltd., Varna.

3.2 Pedagogical activity of the candidate

The teaching activity of Assoc. Prof. Dikova is entirely related to the topic of the competition. Four textbooks have been written, published and used in the education of dental students, two of them in Bulgarian and two in English. Six curricula in three subjects have been developed and regularly updated. Four curricula of these are for students in Bulgarian educational program and two - for English educational program. In the latest curriculum in Dental Materials Science from 2020, the two forms of learning have been developed - face-to-face and distance learning through an electronic-based Blackboard system. A total of seven lecture courses have been developed since 2007. Full lecture courses in five subjects - three of which in Bulgarian and two - in English are regularly given every year to the students from MU-Varna. In the period 2009-2013, two thematic series of lectures had been regularly given to the company "Mauer Locking Systems Ltd." for training students during their internship and for raising the qualification of the staff. A total of eight lectures had been given at foreign universities in Japan, the United States and China.

Assoc. Prof. Dikova has supervised six successfully defended graduates. She has supervised four PhD students who have successfully defended their dissertations, and the number of PhD students trained to date is two.

Assoc. Prof. Dikova has been the Chair of the State Examination Commission in the discipline "Dental Materials Science, Equipment and Instrumentation" of students in the specialty "Dental Technician" at the Medical College of MU-Varna for ten years.

4. Main scientific and applied scientific contributions

4.1 Scientific contributions

1) Original data on the optical properties of dental plastics have been obtained and their leading role in obtaining high-precision details through the stereolithography process has been substantiated.

2) Original data on the adhesion strength of porcelain coating on additively manufactured dental infrastructures for fixed prosthetic construction made of metal-ceramics have been obtained and the interrelation roughness - adhesion strength has been established and explained.

3) For the first time, the stages of nucleation and growth of titanium nanotubes TiO_2 were observed and different mechanisms of their formation on the surfaces of pure titanium and Ti-6Al-4V alloy were established.

4) For the first time, carbon nanotubes were synthesized by chemical gas deposition (CVD) process on anodized surfaces of pure titanium and Ti-6Al-4V alloy without the use of a metal catalyst in the form of nanoparticles.

5) Nanoparticles of CdSe and gold were synthesized by various chemical methods and a comparative analysis of their optical properties was performed.

6) The structural features of martensite and residual austenite in cast irons, surface treated with concentrated energy fluxes, as well as the mechanism and morphology of ferrite changes under laser and electron beam exposure to Fe-C alloys are explained.

7) The structural changes and mechanisms of formation, and development of cracks and fracture of details from austenitic X6CrNiMoTi17-12-2 (1.4571), and austenitic-ferritic steel 105MA (1.4892) are explained, caused by corrosion during operation in a gaseous medium at high temperature, and under cyclic thermo-mechanical impact.

4.2 Scientific and applied contributions

1) Original data have been obtained on the structure and properties of two of the main groups of dental materials - dental plastics and dental alloys, produced using various additive technologies.

2) The technologies for 3D printing of dental constructions have been evaluated and original data on the accuracy, as well as on their mechanical and tribo-corrosion properties have been obtained.

3) The technological regimes have been established for formation of oxide layer on pure titanium and on Ti-6Al-4V alloy in the form of titanium nanotubes. Original data have been obtained on the morphology, chemical and phase composition of the surface oxide layer.

4) Original data have been obtained for the adhesion of nanocoatings of titanium oxides on the surface of both materials titanium and Ti-6Al-4V alloy.

5) Original data have been obtained on the properties and application of different groups of materials for direct and indirect restorations of defects in teeth and dentitions - cements, composites and ceramics, as well as the capabilities of the equipment for their manufacture.

6) New data have been obtained on the microstructure, phase composition and properties of tool, heat-resistant and austenitic steels, surface treated or welded with additional material by means of a laser and subjected to additional thermal, thermo-cyclic or chemical effects.

7) New data have been obtained for the structural transformations and changes in the hardness of the surface layer of Armco-iron after combined plasma-arc treatment and surface plastic deformation.

8) New data were obtained on the morphology, topography and chemical composition of surfaces of pure titanium and Ti-6Al-4V alloy treated with a picosecond laser.

9) New data were obtained on the surface morphology and corrosion behaviour of laser molten layers of austenitic stainless steel in different media - saline and artificial saliva.

4.3 Applied contributions

1) Algorithms and correction factors for the design of virtual models have been developed and proposed, as well as a set of modern additive technologies for obtaining of temporary and permanent fixed prosthetic structures with high quality.

2) Clinical and laboratory protocols for treatment with fixed prosthetic structures (crowns and bridges) have been created, which are the basis for a systematic approach and optimization of the work of prosthetic dentists and dental technicians using 3D printing technologies.

3) A coating of titanium nanotubes on pure titanium and Ti-6Al-4V alloy is made by anodizing.

4) The devices for photo polymerization of dental composites and the stability of the light intensity of different brands of wireless LED lamps have been evaluated.

5) The accuracy of the laser cutting process is determined and the factors that influence are established - the parameters of the laser, the technological regimes, the thermo-physical properties of the material and the dimensions of the sample.

6) New methods, technologies and equipment for "deep surface hardening" of large rotary parts and tools made of structural, carbon, alloy or low-alloy tool steels have been developed and implemented in production.

7) A methodology for designing equipment for cold sheet stamping has been developed and published, including algorithm, formulas, material properties and calculation schemes for construction of the main types of stamps - cutting, bending, drawing.

8) Projects, new products and equipment have been developed for implementation in the production of a high-performance machine with numerical control, a production line for the assembly of locks, as well as various types of secret locks and locking systems.

9) Tool equipment has been developed including moulds for casting, stamps for cold plastic deformation, series of devices, calibres and templates and has been implemented in the production of locking systems.

10) Three company standards and norms have been developed, which have been implemented on paper and electronic version in the ERP system for electronic management of the company for direct use by the individual directorates and workshops. Developed and implemented two procedures for assessing the conformity of products with the essential requirements of European directives - CE marking.

5. Critical remarks and recommendations

I do not have critical remarks and recommendations that would call into question the scientific, scientifically applied and applied contributions of the candidate.

6. Personal impressions

I know Assoc. Prof. Dikova from the procedure for defending the dissertation for obtaining the scientific degree "Doctor of Science", where I was also a reviewer. The whole research and applied activity of Assoc. Prof. Dikova is thematically related to the announced competition and shows that it solves both serious scientific problems equally well and actively participates in the use of modern technologies and creation of advanced materials with new useful properties. The scientific production, presented in the competition, characterizes Assoc. Prof. Dikova as a highly qualified researcher with extensive experience in the scientific specialty "Materials Science and Technology of Machine-Building Materials".

7. Conclusion

The presented materials fully meet in volume and content the requirements of the Law on Development of the Academic Staff in the Republic of Bulgaria, The Implementing Regulations to the Law and the requirements of the Medical University "Prof. Dr. Paraskev Stoyanov" Varna for holding the academic position "Professor". The candidate is a world-renowned scientist, able to solve complex scientific, scientific-applied and applied problems in the field of theory and practice of materials science. After getting acquainted with the materials presented by the candidate, scientific, scientific-applied and applied contributions, and analysis of their significance, I confidently give my positive assessment and recommend the Scientific Jury to prepare a proposal to the Academic Council of the Medical University "Prof. Dr. Paraskev Stoyanov"- Varna for the election of Assoc. Prof. Eng. DSc Tsanka Dimitrova Dikova to the academic position of "Professor" at the Faculty of "Dental Medicine".

28.09.2020

Signature:.....

/Prof. PhD Eng. Stoyko Atanasov Gyurov/