ABSTRACTS of PUBLICATIONS

of Assoc. Prof. Tsanka Dimitrova Dikova DSc, PhD, Mech. Eng.

submitted for participation 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

specialty „Materials science and technology of machine-building materials"

I. PUBLICATIONS INCLUDED IN A REFERENCE ACCORDING TO A MODEL PROVING COMPLIANCE WITH THE MINIMUM REQUIREMENTS FOR OCCUPYING THE ACADEMIC POSITION "PROFESSOR", ACCORDING TO THE LAW ON THE DEVELOPMENT OF THE ACADEMIC STAFF IN THE REPUBLIC OF BULGARIA, 2018.

CRITERION A

INDICATOR 1. PhD thesis

1. ***DikovaT.,*** *Investigation the Behavior of Steels 5ChNM (L6), 3Ch2W8F (H21) and 4Ch5MFS (H11) in Laser Treatment and Thermal Cycling*, TU-Varna, Specializing Scientific Council "Mechanical Technology and Machines", High Testimonial Committee– Sofia, Bulgaria, 2004.

In the dissertation the microstructure and the properties of surface layers of steels 5ChNM, 3Ch2W8F and 4Ch5MFS, processed at different modes of influence with a continuous CO_2 laser are investigated. The changes that occur in them during thermal cycling are reflected. The kinetics of the development of cracks from thermal fatigue of the laser-hardened layers has been studied. It was found that after laser treatment without melting, accelerated propagation of cracks is observed, and in melting modes the kinetics are different and is determined by the microstructure of the surface layer formed during thermocycling. A methodology for selection of technological parameters of laser impact has been developed, recommended technological regimes for steels 3Ch2W8F and 4Ch5MFS have been established and working nomograms have been created.

CRITERION B

INDICATOR 2. DSc thesis

1. ***Dikova T.,*** *Properties of additively manufactured dental materials*, TU-Gabrovo, Bulgaria, 2019, 260p.

The present work explores the peculiarities of a new group production technologies – additive technologies. With its advantages, it is a promising and successful alternative to conventional technologies in the production of traditional and personalized constructions with complex shapes in dental and general medicine. The properties of two of the main groups of dental materials - dental polymers and dental alloys produced using different additive technologies – digital projection and laser based stereolithography, fused deposition modelling and selective laser melting, were studied using standard and new methodologies and approaches. It has been found that this type of technologes provides higher accuracy, mechanical and tribo-corrosion properties. The main role of the optical properties of dental polymers for manufacturing of high precision details through the stereolithography process is justified. It has been found for the first time, that the increased surface roughness of dental alloys, fabricated using additive technologies, is an advantage in production of metalceramic fixed partial dentures as it results in a higher adhesion strength of the porcelain coating. On the basis of the results obtained, correction coefficients and algorithms for design of virtual models were proposed as well as a range of improved technologies for production of high-quality temporary and permanent fixed partial dentures using additive technologies were developed.

CRITERION C

INDICATOR 3 Published habilitation thesis - monograph

1. ***Dikova T.,*** *Cobalt-Chrome Dental Alloys Produced by Selective Laser Melting*, Steno and MU-Varna, 2018, 202 p.

An in-depth study of the mechanical properties of Co-Cr dental alloys, produced by selective laser melting, was made in the present work. The results are analyzed based on the peculiarities of the SLM process and on comparison with the conventionally cast Co-Cr dental alloy. Standard and newly developed methodologies are used, which are a combination of experiment and simulation analysis. The microstructure, defects, hardness and strength characteristics of Co-Cr dental alloys produced by selective laser melting are investigated. The adhesion strength of a porcelain coating to two alloys has been studied – laser built and conventionally cast. The adhesive-cohesive mechanism of demolition of the coating from the metal base is justified. The bending strength of one of the high-loaded four-part dental bridges - from the 1-st premolar to the 2-nd molar, produced by Co-Cr dental alloys through SLM and casting, is studied. The destruction mechanism of the laser built bridges, different from those of the cast ones, is established which is determined mainly by the features of microstructure and the defects in it. For the first time study of the tribo-corrosion properties in artificial saliva of Co-Cr dental alloys, produced by SLM, is done.

CRITERION D

INDICATOR 5. Published monograph, which is not presented as a major habilitation thesis

1. ***Dikova T.,*** *Design of equipment for cold sheet stamping,* Steno, Varna, 2013, 112 p.;

The book is the result of many years of experience of the author as a designer of tool equipment. It is intended to facilitate the work of engineers in the design of stamps and the training of students in the development of coursework and projects. The book discusses the main types of stamps - cutting, bending, pulling and step. It consists of ten chapters, in which with the help of many examples, illustrations, schemes and tables are given: 1) Algorithm for design of stamps; 2) The formulas for calculating the working dimensions of the forming parts and for determining the punching force; 3) The principles of choosing a press machines; 4) The design features of the individual details of the tools; 5) Data about the materials to be processed by plastic deformation; 6) Data of the materials used to make the punches and their respective heat treatments. It is especially valuable that the designations of the materials are shown according to the old standards BDS, GOST and DIN, as well as according to the new Euro-norms EN and the American standard AISI.

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

No	Paper	Referenced in:
1.	Dzhendov D, ***Dikova T***, *Application of selective laser melting in manufacturing of fixed dental prosteses*. J of IMAB. 2016 Oct-Dec; 22(4): 1414-1417. DOI: https://doi.org/10.5272/jimab.2016224.1414;	Web of Science, Scopus Cite score 2017=0.1 **SJR 2017=0.103** SNIP 2018=0.295

Abstract:

The additive technologies characterize with thebuilding of one layer at a time from a powder or liquid thatis bonded by means of melting, fusing or polymerization.They offer a number of advantages over traditional meth-ods: production of complex personalized objects withoutthe need of complex machinery; manufacturing of partswith dense as well as the porous structure and predeterminedsurface roughness; controllable, easy and relatively quickprocess. The methods, mostly used in prosthetic dentistry,include stereolithography, selective laser sintering, and se-lective laser melting. The aim of the present paper is to review the features of the Selective Laser Melting (SLM) proc-ess and the possibilities of its application for productionof fixed dental prostheses.The features of the SLM process, the microstructureand mechanical characteristics of dental alloys as well asthe properties of fixed dental prostheses, fabricated viaSLM, were discussed. It was revealed that the SLM Co-Crdental alloys possess higher mechanical and tribo-corro-sion properties, comparatively good fitting ability andhigher adhesion strength of the porcelain comparing to thecast alloys. All this is a good precondition for successfulapplication of the SLM process in the production of fixeddental prostheses, mainly of frameworks for metal-ceramicand constructions covered with polymer/composite, in-tended for areas with high loading.

No	Paper	Referenced in:
2.	***Dikova T.,*** Dzhendov D., Ivanov D., Bliznakova K., *Dimensional accuracy and surface roughness of polymeric dental bridges produced by different 3D printing processes*, Archives of Materials Science and Engineering, 2018 Dec;94(2):65-75.	Scopus Cite score (2018)=1.0 **SJR 2018=0.22** SNIP 2019=0.478

Abstract:

Purpose: To compare the dimensions accuracy and surface roughness of polymeric dental bridges produced by different 3D printers.

Design/methodology/approach: Four-part dental bridges were manufactured by three printing systems working on the basis of digital light projection (DLP) stereolithography (SLA), laser-assisted SLA and fused deposition modeling (FDM). The materials used from SLA printers are liquid methacrylate photopolymer resins, while FDM printer use thin wire plastic polylactic acid. The accuracy of the external dimensions of dental bridges was evaluated and the surface roughness was measured.

Findings: It was found that compared to the base model, the dimensions of the SLA printed bridges are bigger with 1.25%-6.21%, while the corresponding dimensions of the samples, made by FDM are smaller by 1.07%-4.71%, regardless the position of the object towards the substrate. The samples, produced by FDM, are characterized with the highest roughness. The average roughness deviation (Ra) values for DLP SLA and lase-assisted SLA are 2.40 μm and 2.97 μm, respectively.

Research limitations/implications: For production of high quality polymeric dental constructions next research should be targeted to investigation of the polymerization degree, stresses and deformations.

Practical implications: Our study shows that 3D printers, based on laser-assisted and DLP SLA, can be successfully used for manufacturing of polymeric dental bridges – temporary restorations or cast patterns, while FDM system is more suitable for training models. The results will help the dentists to make right choice of the most suitable 3D printer.

Originality/value: One of the largest fixed partial dentures – four-part bridges, produced by three different commercial 3D printing systems, were investigated by comparative analysis. The paper will attract readers' interest in the field of biomedical materials and application of new technologies in dentistry.

3.	***Dikova, T.D.,*** Dolgov, N.A., Vasilev, T.G., Katreva, I.P. *Adhesion Strength of Ceramic Coatings to Dental Ni–Cr Alloy Fabricated by Casting with 3D Printed Patterns*, Russ. Metall. (2019) 2019: 385. https://doi.org/10.1134/S0036029519040086;	Web of Science, Scopus Cite score (2019)=0.6 **SJR 2019=0.265** SNIP 2019=0.649 **IF(2018)=0.32**

Abstract:

The adhesion of IPS InLine ceramics to a cast dental Ni–Cr (Wiron light) alloy is experimentally studied during the tensile test of flat coated specimens, and the results of a numerical simulation and multicriteria optimization using the MADMML software package are presented. Casting patterns were printed on a 3D Rapidshape printer at angles of 0° and 90° by a layer 35 and 50 µm thick. The adhesion strength of the coating is 77.9–79.9 MPa under optimum conditions.

4.	***Dikova T.*** (2020) *Specifics in Production of Fixed Partial Dentures Using 3D Printed Cast Patterns*. In: Mitrovic N., Milosevic M., Mladenovic G. (eds) Computational and Experimental Approaches in Materials Science and Engineering. CNNTech 2019. Lecture Notes in Networks and Systems, vol 90. pp. 92-102. Springer, Cham, Print ISBN 978-3-030-30852-0, Online ISBN 978-3-030-30853-7, DOI: 10.1007/978-3-030-30853-7_6;	Scopus Cite score (2019)=0.4 **SJR 2019=0.125**

Abstract:

Present paper deals with the specifics in production of fixed partial dentures (FPD) using 3D printed cast patterns. The cast patterns of four-part dental bridges were manufactured of polymer NextDent Cast using RapidShape D30 printer. Two cases of application of cast patterns were discussed – for production of press-ceramic and metallic constructions. The metallic samples were cast by centrifugal casting of Co-Cr and Ni-Cr dental alloys using different investment materials and heating regimes of the casting mold. The dimensions of polymeric cast patterns and cast bridges were measured. It was established that for production of FPD with high accuracy and high adhesion of porcelain coating, precise cast patterns should be manufactured by 3D printing. The dimensions of virtual model should be corrected with coefficients, specific for each axes. The increased roughness of 3D printed cast patterns is disadvantage in dental constructions with high smoothness requirements and advantage for metal-ceramic FPD. Therefore, the position of patterns with respect to the building direction should be different for FPD of press-ceramics and cast infrastructures for metal-ceramics. In the first, vertical axes of teeth must be parallel to the print direction Z-axis, and in the second, they have to be at an angle between 45° - 70° to the base. For ensuring high adhesion strength of porcelain coating in metal-ceramic restorations, surface smoothing operations should not be applied to 3D printed cast patterns. The revealed specifics would be very useful in dental practice for manufacturing of accurate FPD using 3D printed cast patterns.

5.	Dzhendov D., Katreva I., ***Dikova T***. *Development of treatment protocol with selective laser melted fixed partial dentures.* Archives of Materials Science and Engineering. 2018 April;90(2):68-73;	Scopus Cite score (2018)=1.0 **SJR 2018=0.22** SNIP 2019=0.478

Abstract:

Purpose: of the present paper is to offer treatment protocol with fixed partial dentures, produced by selective laser melting, including clinical and laboratory parts.
Design/methodology/approach: The treatment protocols with selective laser melted fixed partial dentures was developed on the basis of literature survey and our previous research about accuracy and mechanical properties of dental bridges, manufactured by additive technologies.
Findings: The treatment protocol with fixed partial dentures, produced by selective laser melting, consisting of clinical and laboratory parts, was developed. The treatment procedures with FPD made by SLM were classified as semi-digital when working with extraoral scanner and fully-digital – with intraoral scanner.
Research limitations/implications: The introduction of the proposed treatment protocol into the clinical and laboratory practice would lead to a systematic approach and working optimization for prosthodontists and dental technicians when using selective laser melting.
Practical implications: Due to the elimination of multiple manual manipulations and technological operations, treatment protocols with FPD, produced by SLM, ensure higher accuracy and quality of the constructions and shorter time for their manufacturing compared to the conventional procedure.
Originality/value: The developed clinical and laboratory protocols for the treatment and manufacturing of FPD through SLM clearly show the benefits of the new technology in dentistry and dental technician field

6.	Dzhendov D., Katreva I., ***Dikova T***. *Prosthetic treatment protocol with fixed dental constructions made on 3D printed cast patterns.* Archives of Materials Science and Engineering. 2018 March;90(1):33-40;	Scopus Cite score (2018)=1.0 **SJR 2018=0.22** SNIP 2019=0.478

Abstract:

Purpose: of the present paper is to develop prosthetic treatment protocol for fixed partial dentures made of 3D printed cast patterns.
Design/methodology/approach: The clinical and laboratory protocols for manufacturing of fixed prosthetic constructions upon 3D cast patterns are developed on the basis of the literature review and our previous experimental investigations. Comparison between the conventional technique and innovative approach is made.
Findings: The terms "semi-digital treatment plan" and "fully digital treatment plan" are defined according to the way of obtaining data for the virtual 3D model and the production method of the fixed prostheses. A classification of treatment protocols with non-removable partial dentures

produced by additive technology is developed. Protocols for "semi" and "fully" digitized treatment plans with fixed partial dentures made by casting with 3D printed models are created.

Research limitations/implications: Implementation of the fully digitized protocol for manufacturing of fixed prosthetic constructions via 3D printed prototypes requires specific equipment in the dental office and dental technician laboratory – intraoral scanner and CAD/CAM system with 3D printing machine.

Practical implications: Establishing of systematic clinical and laboratory protocols helps dental specialists to implement the innovative working approach in their practice with no risk of neglecting or omitting of some important procedures which increases the quality and long lasting effect of the dental constructions.

Originality/value: Following the developed protocols reduces the role of the subjective factor in production technology of fixed prosthetic constructions while saving labour and time.

7.	Anastasova R, ***Dikova Ts,*** Panov V. *In vitro study of dental composite roughness and microleakage of repaired obturations by various techniques*. *J of IMAB.* 2019 Jan-Mar;25(1):2419-2425. DOI: 10.5272/jimab.2019251.2419;	Web of Science, Scopus Cite score 2018=0.3 **SJR 2019=0.108** SNIP 2019=0.165

Abstract:

Tooth restoration is one of the most common procedure in dental practice. The replacement of the whole restoration leads to loss of tooth structure and it's weakening, there is a risk of pulp injury, it's time and cost consuming. According to the minimally invasive approach when minimal defects have occurred or the diagnosed defect is localized only in one region of the restoration the repairmant is a better choice than the total replacement of the restoration.

The aim of the present study is to investigate the roughness of the surface of dental composites processed by different technics as well as to assess the micro-leakage between cavity and composite walls and between old and new material after repairment.

Our study showed that the different types of surface treatments of dental composites lead to different roughness, with the highest values being obtained after laser treatment, followed by turbine application and air abrasion. Microleakage in repaired obturations is influenced not only by the roughness of the surface of the "old" material, but also by the chemical composition and physical properties (viscosity) of the used primer and adhesive. The smallest microleakage was obtained in group A, where the "old" composite was treated with a turbine, etched and applied only G-Premio Bond.

8.	***Dikova T,*** Vasilev T, Hristova V, Panov V. *Finite Element Analysis in Setting of Fillings of V-Shaped Tooth Defects Made with Glass-Ionomer Cement and Flowable Composite*. Processes. 2020 Mar;8(3):363. ISSN 2227-9717; CODEN: PROCCO, **IF=1.963;**	Web of Science, Scopus: Cite score (2019)=1.8 **SJR 2019=0.403** **IF(2019)=2.753**

Abstract:

The aim of the present paper is to investigate deformation-stress state of fillings of V-shaped tooth defects by finite element analysis (FEA). Two different materials were used - auto-cured resin-reinforced glass-ionomer cement (GIC) and flowable photo-cured composite (FPC). Two materials were placed into the cavity in one portion, as before application of composite the cavity walls were

covered with thin adhesive layer. Deformations and equivalent von Mises stresses were evaluated by FEA. Experimental study of micro-leakage was performed. The study established an analogous non-homogeneous distribution of equivalent Von Mises stresses at fillings of V-shaped defects, made with GIC and FPC. Maximum stresses were generated along the boundaries of filling on vestibular surface of the tooth and at the bottom of filling itself. Values of equivalent Von Mises stresses of GIC fillings are higher than that of FPC. Magnitude and character of deformation distribution at GIC and FPC fillings are similar - deformation is maximum along the vestibular surface of the filling and is 0.056 mm and 0.053 mm, respectively. In FPC fillings, the adhesive layer, located along the cavity/filling boundary, is characterized with greatest strain. The experimental study of micro-leakage has confirmed the adequacy of models used in FEA.		
9.	***Dikova Ts.,*** Abadjiev M., Balcheva M., *Clinical Application of the Contemporary Nano-materials (part I – laboratory composites), J of IMAB, book2, 2009, p.67-70;*	Web of Science, Scopus Cite score 2017=0.1 **SJR 2017=0.103** SNIP 2018=0.295
Abstract: Nano-technology and nano-materials have become an extremely active field of research in the last decade, because of their potential application in different areas like medicine, information technologies, energy storage etc. The unique properties of nano-sized particles, which are subject of quantum mechanics, determine the great interest. The main purpose of using nano-technologies in dental materials is achieving higher mechanical properties, higher abrasion resistance and less shrinkage of dental composites, improved optical and aesthetic properties of composites and ceramics. Till now the nano-technologies are used in production of wide range of dental materials: light polymerization composites and their bonding systems, imprint materials, ceramics, coatings for dental implants and bioceramics. The aim of this paper is to make an overview of nano-materials, designed for and used in the practice of dental medicine.		

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

1. ***Dikova T.,*** Dzhendov D., Katreva I., Monov A., Dolgov N. *Surface Roughness of Dental Alloys Cast with 3D Printed Polymeric Patterns*, Proceedings of the III-rd Int. Sci. Conference – summer session "Industry 4.0", 18-21.06.2018, Varna, Bulgaria, STUME. 2018 June:62-66.

The present paper deals with investigation of surface roughness of Ni-Cr and Co-Cr dental alloys Wiron light and i-Alloy, cast with 3D printed patterns. The cast patterns were printed by stereolithographic printer Rapidshape D30 of polymer NextDent Cast with 35 µm and 50 µm layer thicknesses, inclined to the basis at 0^o, 45^o and 90^o. It was found that besides the 3D print parameters of the cast patterns, the materials and technological regimes of the casting process also influence to the Ra values. The increased roughness of samples cast of an i-Alloy alloy with patterns, printed inclined (45° and 90°), in relation to those, whose patterns are made parallel to the substrate, is due to the layered morphology on their surface. The high roughness of the Wiron light alloy, cast with patterns printed parallel to the base, is the result of defects obtained during the casting process.

2. ***Dikova Ts.,*** *Synthesis of Carbon Nano-Tubes on Anodized Titanium Surface with no Metal Catalyst*, Nanoscience & Nanotechnology, 14, eds. E. Balabanova, E. Mileva, Sofia, 2014, p.46-49;

The aim of the present paper is to investigate the possibility of synthesys of CNT on anodized Ti surface with no metal catalyst. The Ti-6Al-4V alloy samples were grinded, etched and anodized. The CVD processes lasting 30min, 45min and 1h were done in a tube furnace at temperature 650^{o}C in a gas mixture C_2H_2:Ar with volume ratio 1:5. The samples were investigated by SEM, Raman and XRD analysis. After anodization about 30% of the samples' surface was covered with TiO_2 nanotubes, while the rest part was characterized with nano-roughness. First CNT with a length of about 3µm, random distribution and low density originated on the nanoroughened regions after 30min process. Their density and length gradually increased with increasing of the growth time. After 1h process these regions were covered with long curly CNT. The areas with TiO_2 nanotubes were covered with randomly distributed carbon nano-rods with about 1µm length after 30min process. Increasing of the growth time slightly influenced on the nano-rods length and density.

3. ***Dikova Ts***, Nikolova M., Yankov E., *Adhesion Analysis of Titanium Oxide Nanocoatings on Titanium Surface,* International Journal "Materials Science. Non-Equilibrium Phase Transformations", Issue 1, 2016, pp. 46-51;

Ti and its alloys are mostly used for implant production. Their biocompatibility depends on the formation of thin TiO_2 layer on the surface. It can be improved by modification of oxide structure in tubular. For biomedical applications, the adhesion of the coating layers is essential. The aim of the present paper is to investigate the adhesion of TiO_2 nanocoatings on titanium surface.
Commercially pure Ti (CP Ti) and Ti-6Al-4V alloy samples were grinded, etched and anodized. The anodization was done in 0.5 wt.% HF electrolyte with duration of 7 hours for the CP Ti samples and 6 hours for Ti-6Al-4V alloy samples. The adhesion was investigated by tape and scratch tests. The critical loads that generate the first failures during the scratch test are used for characterization of the adhesion of the TiO_2 nano-tubular coating. The critical loads were measured by CSEM-Revetest macroscratch tester under progressive scratching mode. The samples were characterized by SEM and EDX analysis. The areas around the critical load were further observed by optical and scanning electron microscopy for detail inspection of failure mechanism.
It was established that the higher micro-roughness of the surface of CP Ti sample after anodization is responsible for the detachment only of small areas of the nano-tubular coating situated mainly on the top surface. The lower micro-roughness of the sample made of titanium alloy and the presence of large flat areas lead to detachment of large coating's portions. The scratch test reveals that the TiO_2 nano-tubular coating on the CP Ti fails at an early stage (L_{c1} ~ 8 N; L_{c2} ~ 26 N), while that on the Ti-6Al-4V sample undergoes cohesive failure and completely fails at higher load values (L_{c1} ~ 13 N and L_{c2} ~ 40 N respectively). As titanium alloy is ductile material with higher strength than the CP Ti, it provides better support for the coating and produces higher critical loads.

4. ***Dikova Ts.D.,*** Hahm M.G., Hashim D.P., Narayanan T.N., Vajtai R., Ajayan P.M., *Growth Mechanism of TiO_2 Nanotubes on the Ti-6Al-4V Surface,* Int.Journal "Machines, Technologies, Materials", Issue 11/2012, p.86-89;

Present paper deals with investigation of the mechanism of TiO2 nanotubes growth on titanium surface during anodization process. The samples were made of Ti-6Al-4V alloy. They were grinded, etched with 0,5 wt. % HF acid and anodized. The anodization was done in electrolyte containing 0,5 wt. % HF acid using DC power supply with graphite electrode as cathode. The samples were investigated by SEM, EDAX and XRD analysis. The results show that after 5h anodization the regions with nano-roughness as well as the regions with nanotubes with average internal diameter 102nm exist on the surface of the Ti-6Al-4V alloy sample. The field-enhanced oxidation and field-enhanced dissolution are the main processes for TiO2 nanotubes formation during anodization. The surface micro-roughness influences on the processes running rate in different micro-regions determining origination of the titanium nanotubes on different stage and by different mechanism as well.

5. ***Dikova Ts.,*** *Surface Morphology of Pure Titanium after Anodization*, Int. Journal "Machines, Technologies, Materials", Issue 12/2014, p.3-7, ISSN 1313-0226;

Present paper deals with the investigation of the surface morphology of pure titanium after anodization. Round samples of CP Ti were anodized at different voltages (16V, 20V, 25V, 30V and 40V) in an electrolyte containing 0.5 wt.% HF. The process duration varied from 30min to 7 hours. The samples' surface was observed and EDX analysis was made by SEM. Surface morphology of CP Ti after anodization is defined by the surface roughness before anodization, electrolyte type and process parameters – voltage and duration. It was established that the surface of pure titanium after 3h-7h anodization at all voltages characterizes with large number of craters increasing the surface micro-roughness. At short-term processes only pores with about 2μm diameter were observed. Depending on the regimes used different oxide nanostructures were observed. After short-term anodization in lower voltages the titanium surface was covered with nanodots, nanorods and nanoflakes. Increasing the voltage up to 25 V led to originating of nano-tubular structure in some areas and sponge-like nano-structure at 30 V and 40 V. Increasing the process duration caused increase of the proportion of nanotubes and sponge-like structure to that of nanorods.

6. ***Dikova Ts.,*** Milkov M., *Application of Ti and Ti Alloys in Dental Implantology*, Int. Journal "Machines, Technologies, Materials", Issue 3/2013, p.48-51;

The aim of the present communication is to evaluate the existing scientific evidence on the rising application of titanium and titanium alloys for the preparation of implants in dental surgery. The choice of suprastructure alloy combined with titanium for the oral cavity is still controversial and needs investigations of the electrochemical interaction of the suprastructure/implant couples. Nowadays multiform coated titanium implants are widely used in this field. There exist numerous biomaterials currently used in restorative implant dentistry. Their properties can be assessed by a variety of methods such as histology, histomorphometry, scanning electron microscopy, mechanical testing, computer-quantified tissue morphology, computer-aided design and computer-assisted manufacturing, radiography, three-dimensional finite element analysis, resonance frequency of Astra Tech TiO_2 blasted implants at second surgery, etc. Implant stability is considered as a factor influencing on the achievement of osseointegration. The stability of titanium dioxide grit-blasted dental implants is improved with fluoride treatment during the first six months following implant placement. A special attention should be paid to antibacterial/bacteriostatic titanium, titanium nanocoating and nanopatterning as well as to antimicrobial drug/titanium implant. Both early and immediately loaded implants present with a high clinical level of osseointegration as shown by the bone-titanium interface of immediately loaded and submerged titanium implants. A superior biocompatibility and osteogenic efficacy of micro-arc oxidation-treated titanium implants is experimentally proved. The analysis of effects of titanium ions on the cell viability and differentiation demonstrates that they exert the biological effects, both on the viabilities of osteoblast and osteoclast and on the differentiation of either the osteoblastic or osteoclastic cells, which may influence on the prognosis of dental implants. Further studies would try to elucidate the benefits of titanium and its alloys in dental implant surgery.

7. ***Dikova Ts.D.,*** *Nano-Engineered Coatings on Titanium Implants,* Scripta Scientifica Medica, 2012, vol. 44(2), p.23-25;

The present paper deals with the latest developments in nanoscale coatings on titanium implants. The main problems of dental implants and the main advantages of nanotechnologies are discussed. Precisely defined structures commensurable with the bone structure can be created on the implant surfaces using various nanotechnologies. Nanostructured coatings improve bioactivity and biocompatibilty influencing the whole process of osteoblast integration.

8. Panova N., Ilieva M., ***Dikova Ts.,*** Tonchev Ts., *Морфология на повърхността на стомана AISI 321 след лазерно стопяване и електро-химична корозия в изкуствена слюнка, ,* Сборник на 8 МНК за млади учени "Technical Science and Industrial Management", 15-16.09.2014, Варна, България, Vol.1, 18-21с.;

The purpose of the present paper is to examine the surface morphology of laser-melted layers of austenitic stainless steel after electro-chemical corrosion tests in Artificial Saliva (AS). Samples of steel AISI 321 (EN X6CrNiTi 18-10) are subjected to a surface treatment with continuous CO_2 laser, which provides surface melting. After that the electro-chemical corrosion tests in artificial saliva (Fusayama Meyer) with different acidity - pH 5,6 and pH 6,5 were done. The free potentials E_f until reaching steady state potentials E_{ss} and potentiodynamic anodic polarization were examined. The surface morphology was observed by SEM and an optical microscope. Two types of corrosion - pitting and crevice were observed on the surface of all the samples regardless of the solution acidity. The pittings formed possess relatively small sizes 150-300 μm and their quantity is larger in laser-melted layers compared to the base metal. During electro-chemical tests in AS with pH 6,5 there is nearly no difference between Ess and Epit of base metal and laser-melted layers. But when tested in AS with pH 5,6 the laser-melted layers showed lower resistance to pitting corrosion compared to the base metal. The pitting formed in lower pitting potentials Epit (+526/+684 mV), while Epit of base metal is +802 mV. The lower corrosion resistance of laser-melted layers of austenitic stainless steel in artificial saliva with pH 5,6 is mainly due to the acidity of the media and the additional effect of acetic acid on decreasing the resistance to pitting formation as well.

9. ***Dikova Ts.,*** Balcheva M., Panova N., Simov M., *Investigation the Corrosion Behavior of Laser Melted Layers of AISI 321 Stainless Steel,* Int. Journal "Machines, Technologies, Materials", Issue 9/2013, p.19-22;

The purpose of present paper is to investigate the corrosion behavior of laser melted surface layers of austenitic stainless steel, immersed into physiological solution. The samples are made of Ch18N10T GOST (AISI 321, EN X6CrNiTi 18-10) steel and their surface is melted by continuous CO_2 laser. Then they are polished to different roughness grade and immersed into Ringer's solution at 37^{o}C temperature for 90 days. The corrosion behavior is investigated by measuring the electrode potential, visual, micro-structural and phase analysis through optical microscopy and XRD-analyzer. The initial mono-phase austenitic microstructure and its morphology change after Laser Surface Melting (LSM). The melted surface layer consists of austenite with dendrite morphology and delta-ferrite in the dendrites core. The delta-ferrite quantity is minimal on the surface and maximal in the melted pool bottom. The nonmetallic inclusions, typical for the initial microstructure, could not be seen in the melted layer. The electrode potential of the initial metal sample and the laser melted layers is about 190-250mV at 37°C temperature. This value doesn't change during the tested period. Different roughness grades do not considerably influence the electrode potential. The visual and micro-structural analysis shows there are no changes in the microstructure of the subsurface layer. Since the LSM leads to refining of the surface layers and the second phase (delta-ferrite) quantity on the surface is minimal, this type of treatment of the austenitic steel does not bring to considerable changes of its corrosion behavior.

10. Simov M., ***Dikova Ts.,*** *Special Features of ZrO_2 and Technologies for Dentures Manufacturing,* Int. Journal "Machines, Technologies, Materials", Issue 1/2013, p.47-49;

Present paper deals with the peculiarities of the ZrO2as one of the up-to-date and very often used materials for denturesmanufacturing last 10 years. The structure, properties and types of zircon are discussed in details. Different technologies for milling ofdental constructions of ZrO2are presented. The peculiarities of CAD/CAM and MAD/MAM (Manual-Aided Design, Manual-AidedManufacturing) systems are considered. It was concluded that zircon will havewider and wider application as a material for denturesbecause of its high flexural strength and fracture resistance. The new improved CAD/CAM systems play important role for manufacturing ofprecise dental construction of ZrO2.

11. Simov M., ***Dikova Ts.,*** Georgiew G, *Features of the technology for aesthetic restoration with thin non prep veneers - lamineers.* Varna Medical Forum, 2013:2(3);256-261;

Restoration of teeth with ceramic veneers is a scientifically proven effective method. The time they last in patients' mouth is similar to that of crowns. The all-ceramic veneers offer advantages in the prosthetic process such as the minimal loss of dental tissues, long lasting aesthetics and minimal wear and tear of the veneers. They could be used for correcting the shape and size of the teeth, in diastems, colouring and fractures as well as for corrections of the teeth position. In the present paper, the peculiarities, application and technologies for fabrication of thin non prep veneers (lamineers) are considered. It has been established that the best way to achieve better aesthetics is minimum preparation of the tooth surface and application of thin veneer.

12. Simov M., ***Dikova Ts.,*** *Reinforced dental ceramics,* Varna Medical Forum, 2012; 1(1):145-148;

Dental ceramic is the most promising restorative material. The growing demand of high quality aesthetic restorations during the last 30 years led to the development of new all ceramic materials with considerably improved mechanical properties. The aim of the present paper is to make a review of all ceramic dentalmaterials and related technologies as well as to estimate their advantages and disadvantages on the basis ofthe last scientific achievements and our own laboratory practice.

CRITERION E

INDICATOR 23 Published university textbook

1. **Дикова Ц.,** *Дентално материалознание,* Част 2, МУ-Варна, Варна, 2015, 160с. – in Bulgarian;

The present book consists of two chapters – lecture notes and laboratory classes' reports. This is the first part of the textbook "Dental materials science", intended for the students of dentistry. The textbook is developed on the basis of the lectures on dental materials science according to the approved syllabus of the Dental Faculty at the Medical University of Varna.

The lecture notes' chapter includes topics on general materials science: structure of materials and their properties - physical, optical, mechanical and technological. The introduction to dental materials begins with metals, alloys and gypsum. Along with the theoretical knowledge, many practical advices can also be found.

The laboratory classes' reports chapter consists of templates of reports. They are designed for the self-study of students during laboratory classes and at home. The aim, type of training, equipment and instruments needed as well as the practical tasks, are noted. The students should write a summary and a conclusion answering the questions given.

This book is very useful for dental students during lectures, their work in laboratory classes and especially in preparation for practical and theoretical exams. Although it is addressed to the first year students, it could also be helpful to the final year students and young dentists to understand their mistakes in the application of dental materials.

2. **Дикова Ц.,** *Дентално материалознание,* Част 1, МУ-Варна, Варна, 2014, 148с. – in Bulgarian;

The present book consists of two chapters – lecture notes and laboratory classes' reports. This is the second part of the textbook "Dental materials science", intended for the students of dentistry. Textbook is developed on the basis of the lectures on dental materials science according to the approved syllabus of the Dental Faculty at Medical University of Varna.

The lecture notes' chapter includes topics on the three main groups of dental materials: clinic, subsidiary and laboratory. The composition, manipulation, properties and usage of the polymers, ceramics, impression materials, cements, amalgams and composites are discussed. The perspectives of their development are traced out, along with the theoretical knowledge many practical advices can also be found.

3. **Dikova Ts.,** *Dental Materials Science, Lectures and laboratory classes notes,* Part II, MU-Varna, Varna, 2014, 150 p. – in English;

The present book consists of two chapters – lecture notes and laboratory classes' reports. This is the first part of the textbook "Dental materials science", intended for the students of dentistry. The textbook is developed on the basis of the lectures on dental materials science according to the approved syllabus of the Dental Faculty at the Medical University of Varna.

The lecture notes' chapter includes topics on general materials science: structure of materials and their properties - physical, optical, mechanical and technological. The introduction to dental materials begins with metals, alloys and gypsum. Along with the theoretical knowledge, many practical advices can also be found.

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This book is very useful for dental students during lectures, their work in laboratory classes and especially in preparation for practical and theoretical exams. Although it is addressed to the first year students, it could also be helpful to the final year students and young dentists to understand their mistakes in the application of dental materials..

4. **Dikova Ts.,** *Dental Materials Science, Lectures and laboratory classes notes,* Part I, MU-Varna, Varna, 2013, 128 p. – in English;

The present book consists of two chapters – lecture notes and laboratory classes' reports. This is the second part of the textbook "Dental materials science", intended for the students of dentistry. Textbook is developed on the basis of the lectures on dental materials science according to the approved syllabus of the Dental Faculty at Medical University of Varna.
The lecture notes' chapter includes topics on the three main groups of dental materials: clinic, subsidiary and laboratory. The composition, manipulation, properties and usage of the polymers, ceramics, impression materials, cements, amalgams and composites are discussed. The perspectives of their development are traced out, along with the theoretical knowledge many practical advices can also be found.

II. PUBLICATIONS DIFFERENT TO THESE, INCLUDED IN THE EVIDENCE FOR COVERING THE MINIMUM REQUIREMENTS FOR THE ACADEMIC POSITION "PROFESSOR"

A) FULL-TEXT PUBLICATIONS IN FOREIGN SCIENTIFIC JOURNALS

<table>
<tr><th>No</th><th>Paper</th><th>Referenced in:</th></tr>
<tr><td>1.</td><td>Stavrev D., Dikova Ts., Structure Features of Martensite and Residual Austenite in Treatment by Concentrated Energy Fluxes, Advanced Materials Research Vols. 83-86 (2010) pp. 889-895; www.scientific.net/AMR.83-86.889;</td><td>Scopus
SJR 2010=0.155
SNIP 2017=0.181</td></tr>
<tr><td colspan="3">Abstract:
The paper deals with the structure features of Fe-C alloys quenched by means of laser, electron beam and plasma arc. The martensite and residual austenite obtained are highly inhomogeneous. Their morphology and distribution depend both on the initial state before quenching and on the kinetics of the temperature changes. Four different structures of martensite are observed – package, lamellar isothermal, lamellar thermo-kinetic and "feathery nest-like". The new martensite structure observed, called by us "feathery nest-like", is a result of explosive austenite-martensite transformation in pearlitic irons. It differs from the classic modification in its specific morphology. Low-carbon package martensite occupies the regions of the former ferrite grains. Its hardness reaches 1050-1150 HV0.1. In the regions of microstructure with increased carbon concentration, lamellar martensite is observed. The residual austenite is with different proportion in relation to the martensite. In particular regions its quantity could reach 100%. It is characterized by a high quantity of imperfections and high mechanical properties. Its hardness reaches 450-500 HV0.1. The higher the power density and the lower the energy density of the concentrated energy flux, the higher the residual austenite quantity.</td></tr>
<tr><td>2.</td><td>Stavrev D., Dikova Ts., Structure and Properties of High-Alloyed by Cr Upper-Eutectoid Steels after Hardening by Concentrated Energy Fluxes, Advanced Materials Research Vols. 83-86 (2010) pp. 896-903; www.scientific.net/AMR.83-86.896;</td><td>Scopus
SJR 2010=0.155
SNIP 2017=0.181</td></tr>
</table>

Abstract.

The present paper deals with the structure and properties of two types of tool steels with high chromium content (12% Cr) hardened by means of Concentrated Energy Fluxes (CEF). The treatment conditions are chosen to ensure liquid state transformations. The melted zone of the surface layer features a quasi-ledeburite structure, consisting of inhomogeneous residual austenite and Cr-containing carbides of MmCn type. This austenite is strongly cold hardened and oversaturated with Cr and carbon. The micro-hardness of this region varies from 400 up to 800 HV0.1. The higher the energy density, the lower the hardness and the wider the modified layers. The lower hardness is due to the presence of nearly 100% austenite. Higher hardness was obtained in the heat affected zone. Carbides of M23C6, M7C3, M6C, M3C and c□ types were identified. A scheme of carbide changes after treatment with CEF is given.

3.	***Dikova Ts.,*** Stavrev D., *Microstructure and Properties of Hot-Work Tool Steels under Laser Surface Melting and Thermal Cycling,* Proceedings of the 8th Workshop on Application of Laser in Mechanical Industries WALMI 2010, Jan. 7-9, 2010, Kolkata, India, p.85-97;	-

Abstract:

The present paper deals with the microstructure transformations, hardness changes and thermal fatigue micro-cracks in the melted zone of steels AISI H11 and H21 after laser surface treatment and thermal cycling. The tested samples are processed by a continuous wave CO2 laser, operating in a mode providing melting of the surface layer. After that they are subjected to thermal cycling by heating in a melted aluminum alloy at Tmax=680 0C and cooling in water at Tmin=200C. Light optical and SEM metallography, X-ray diffraction analysis and durometric analysis are carried out. The parameters of the maximum – Lmax and average – Lav length of the micro-cracks in the cross section of the samples were used for the quantitative estimation of their propagation.

It is found out that after laser treatment the microstructure in the melted zone has a dendrite structure and comprises of packet martensite, residual austenite and □-ferrite. Moreover, carbides of the type M6C are observed in H21 steel. The laser surface melting provides an increase of the surface layer hardness of both studied steels with about 250HV5. After thermal cycling the microstructure of the melted zone is characterized with fine morphology, while the hardness drops at the initial cycles. The transformations are conditioned by the type of the carbide phase released in the initial stage - M6C and M23C6 for steels H21 and H11 accordingly, which can decelerate or accelerate the development of the tempering processes. For this reason the hardness of the melted zone of H21 steel remains comparatively high, whereas for H11 it is equalized with the hardness of the sample from the initial stage.

It was established that the mechanisms of the thermal fatigue micro-cracks appearance and propagation are identical in the steels treated by laser and in the steels subjected to the volume heat treatment. Micro-cracks appearance on the laser-hardened layers occurs mainly on the sample surface in the first dozen thermal cycles. Kinetics of the micro-cracks development at the laser remelted layer is different than this in the base material owing to the microstructure. Effective detention of micro-cracks development occurs when enough depth of the dispersive microstructure exists. The most suitable regime for laser treatment is the one that ensures the depth of the melted zone is not less than 0,2 mm.

<table>
<tr><td>4.</td><td>Ivanov Ivan, Dikova Ts., Stavrev D., Combined Plasma-Arc Treatment And Surface Plastic Deformation Of Armco-Fe, International Conference on Advances in Materials and Processing Technologies (AMPT2010). AIP Conference Proceedings, Volume 1315, pp. 1305-1310 (2011);</td><td>Web of Science, Scopus</td></tr>
<tr><td colspan="3">Abstract.

Present paper deals with the structure transformations and hardness changes of the surface layer of Armco-Fe after combined Plasma-Arc Treatment (PAT) and Surface Plastic Deformation (SPD). The SPD was realized by rotational-progressive movement of spherical contra-body. Optical microscopy, TEM and durometric investigations were used. The processes of structure hardening in the melted zone of surface layer after PAT were analyzed. The formation of high-carbon martensite near former cementite inclusions as well incoherent secondary phase precipitations in heat affected zone were established. The hardness in the melted zone increases up to 320-350 HV while in the heat affected zone it smoothly decreases to 120 HV. The following SPD leads to deformation hardening of the samples' surface layers. The investigations show that this is due to the phase cold hardening in precrystallization processes, incoherent secondary phase precipitation along the boundaries as well the higher dislocation density. After SPD, formation of cell substructure with incompact walls was established in the melted zone. As a result of contact or low-cycle fatigue the crack origination and propagation along the boundary between the melted zone and heat affected zone were observed.</td></tr>
<tr><td>5.</td><td>Stavrev D., Dikova Ts., Method, Technology and Equipment for In-depth Surface Hardening, Advanced Materials Research Vols. 264-265 (2011) pp 1526-1531;</td><td>Scopus
SJR 2011=0.149
SNIP 2017=0.181</td></tr>
<tr><td colspan="3">Abstract.

The present work deals with a new method, technology and equipment developed for "in depth surface hardening" of large rotary details and tools, made of constructional, carbon, alloyed or low-alloyed tool steels. According to the technical requirements the details and tools have to possess hardened layer with specific shape, depth in the range 20-35mm and surface hardness of 35-62 HRC. The "in-depth hardening" was performed by quenching and self-tempering. Preliminary volume heating and depth regulated local surface adjustable gas-flame heating were used. The gasflame heating was realized by gas-flame burners (CH4+O2) located near the details' periphery, depending on the shape and depth of the hardened layer. The burners' power and heating time were adjustable. The cooling was performed by showers located near the details' periphery also depending on the shape of the hardened layer. Water or polymer water solution was used as cooling media and its capacity was adjusted in the beginning. Due to the heat accumulated during the preliminary heating and the heating up to the quenching temperature of the surface layer, after stopping the cooling, subsequent self-tempering was applied. All of the equipment for realizing the whole hardening cycle, temperature and time control and parameters of heating and cooling was developed. Series of different details were hardened: traversing wheels and gears, forming rolls, rolling disks etc., made of construction and tool steels. The hardened layers obtained were with specific shape, surface hardness in the range of 35-60HRC and depth of the hardened layer of 15-25mm.</td></tr>
</table>

<table>
<tr><td>6.</td><td>Stavrev D., Dikova Ts., Shtarbakov Vl., Milkov M., Laser Surface Melting of Austenitic Cr-Ni Stainless Steel, Advanced Materials Research Vols. 264-265 (2011) pp 1287-1292;</td><td>Scopus
SJR 2011=0.149
SNIP 2017=0.181</td></tr>
<tr><td colspan="3">Abstract.

The present paper deals with the microstructure and hardness distribution in width and in depth of the surface layer of steel Ch18N10T GOST (AISI 321, EN X6CrNiTi 18-10) after surface melting by continuous wave CO2 laser. Light microscopy, XRD analysis and Vickers hardness testing (HV5 and HV0,05) have been used in our research. Phase analysis shows disturbance of the mono-phase initial austenitic structure in the treated layer. The structure of the melted pool consists of austenite with dendrite morphology and δ-ferrite situated in the dendrites' cores. The ferrite has been clearly identified by XRD analysis. As a result from fast heating and cooling, ferrite, obtained by diffusionless sliding mechanism, was observed along the austenite grains' boundaries in the heat affected zone. The presence of small inclusions of supposed Ti carbide, non-identified by XRD analysis, was also observed. The durometric investigations show that the surface hardness in the melted zone is in the range 180-210 HV5 while that of the basic metal is about 270 HV5.</td></tr>
<tr><td>7.</td><td>Ставрев Д.С., Дикова Ц.Д., Иванов И.П., Высокотемпературная газовая коррозия аустенитной Cr-Ni стали, содержащей Mo и Ti, МиТОМ, №10, 2011, с.48-51;</td><td>Импакт-фактор РИНЦ 2018=0,892</td></tr>
<tr><td colspan="3">Abstract:

High-temperature gas corrosion of steel X6CrNiMoTi17-12-2 (1.4571) used for internal structure components of chemical reactors is studied. The condition of individual regions of the structure in various stages of damage is investigated.</td></tr>
<tr><td>8.</td><td>Stavrev D.S., Dikova Ts.D., Ivanov I.P., High Temperature Gas Corrosion of Austenitic Cr-Ni Steel Containing Mo and Ti, Metal Science and Heat Treatment, Vol.53, Nos.9-10, January, 2012, p.508-511, UDC620.178.311.868:669.14.018.8, http://www.springerlink.com/content/j0j6710w75571017/fulltext.pdf</td><td>Scopus:
Cite score (2012)=0.2
SJR 2012=0.145
IF(2012)=0.151</td></tr>
<tr><td colspan="3">Abstract:

High-temperature gas corrosion of steel X6CrNiMoTi17-12-2 (1.4571) used for internal structure components of chemical reactors is studied. The condition of individual regions of the structure in various stages of damage is investigated.</td></tr>
<tr><td>9.</td><td>Dikova Ts., Factors Affecting the Dimensional Accuracy in Laser Cutting, Advanced Materials Research Vol. 445 (2012) pp 430-435, www.scientific.net/AMR.445.430</td><td>Scopus
SJR 2012=0.135
SNIP 2017=0.181</td></tr>
<tr><td colspan="3">Abstract.

This research aims to establish the influence of different factors on the dimensions accuracy in laser cutting. Samples with different thickness were made of DC01 EN 10130 steel. On each sample 32 round or square holes were cut in 4 rows by different laser beam movement schemes– linear, zig-zag and random. The tests were made by pulse CO2 laser with regimes, recommended for each sheet thickness, by the machine operating manual. The diameters of the round holes and the dimensions of the square holes along the laser head and the table axes were measured by a projector. The varying intervals of the dimensions and the shape deviations were calculated. It was established</td></tr>
</table>

that three groups of factors influence on the dimensions accuracy in laser cutting: factors, related to the machine, laser parameters – power, laser cutting speed and focus distance, determining the technological process parameters, and the material characteristics – thermal-physical properties and sample sizes. Factors, related to the machine, exert effect mainly on the intervals of dimensions varying, while the laser parameters and the material properties influence on the dimensions value independently of the cutting scheme. In the all laser cutting schemes the increasing of the sample thickness leads to the larger interval of the dimensions varying and increasing of the shape deviation.		
10.	***Dikova Ts.D.,*** *Influence of Technological Parameters on Titanium Nanotubes Formation,* Recourse Saving Technologies for Production and Pressure Shaping of Materials and Mchine Building, No1 (14) 2013, *p.150-160, http://resource-saving.snu.edu.ua/PDF/E_COPY_2013/statti/dikova.pdf;*	-
Abstract: Present paper deals with investigation of the influence of technological parameters on the titanium nanotubes formation on the surface of pure Ti Grade-2 and Ti-6Al-4V alloy in anodization with graphite cathode. The anodization was done in two concentrations of HF solution in different voltages and process duration. The surface morphology, chemical and phase compositions were investigated by SEM, EDAX and XRDanalyses. It was established that anodization in 0,5% HF solution allows obtaining of oxide layer with nano-tubular structure in narrow voltage range 30V +/-5V for the Ti-6Al-4V alloy and 20-25 V for the pure Ti Gr-2 in a relatively long process duration. The average inner diameter of the nano-tubes is close for the both materials (80 nm - 120 nm) and increases with increasing of process duration. The surface morphology at lower voltages characterizes with nano-roughness in short-term process which changes to TiO2 nano-fibers with increasing of process duration. At higher voltages - 40 V for Ti-6Al-4V alloy and 30 V for pure Ti porous sponge-like structure of the oxide layer is observed. Higher 1,5% HF concentration leads to formation of nano-tubes after 30min process, while increased duration leads to the areas with different morphology – nanotubes, porous microstructure and dense oxide layer.		
11.	***Dikova Ts.D.,*** Hahm M.G., Hashim D.P., Narayanan T.N., Vajtai R., Ajayan P.M., *Mechanism of TiO_2 Nanotubes Formation on the Surface of Pure Ti and Ti-6Al-4V Alloy,* Advanced Materials Research Vol. 939 (2014) pp 655-662;	Scopus **SJR 2014=0.14** SNIP 2017=0.181
Abstract. The present paper deals with the investigation of the mechanisms of TiO_2 nanotubes formation on titanium surfaces during anodization process. The samples were made of pure Ti Grade-2 and Ti-6Al-4V alloy. They were grinded, etched with 0,5 wt. % HF acid and anodized. The anodization was done in electrolyte containing 0,5 wt. % HF acid using DC power supply with graphite electrode as cathode. The samples were investigated by SEM, EDAX and XRD analysis. The results show two different mechanisms of formation of TiO_2 nanotubes on the surfaces of both materials. During the anodization process the oxide formations, obtained on the pure Ti surface after etching, are oxidized to nano-rods; the area between them is also oxidized and connects them. This thin oxide layer grows in the metal depth while the nano-rods are dissolved thus forming the porous "sponge-like" structure which is further transformed in tubular. While on the surface of Ti-6Al-4V alloy oxide nano-nuclei originate which transform their shape from		

"nano-seed" to "bowl-like" with clearly pronounced bottom and walls, growing in tubular structures.
The type of the material defines the surface morphology after etching. Thus obtained morphology influences on the processes running rate in different micro-regions determining origination of the titanium nanotubes on different stage as well as by different mechanism. The field-enhanced oxidation and field-enhanced dissolution are the main processes for formation of TiO_2 nanotubes during anodization. In the regions with prevalent oxidation processes the TiO_2 nanotubes are formed earlier while in the regions with dominant dissolution processes the TiO_2 nanotubes are formed on the later stage.

12.	***Dikova Ts.,*** Tsaneva D., Ilieva M., Panova N., *Electro-Chemical Corrosion of Laser-Melted Layers of Stainless Steel in Ringer Solution*, Book of extended abstracts of VI-th Int. Metallurgical Congress MME, 29 May - 01 June 2014, Ohrid, Macedonia, edited by Sv. Cvetkoski & G. Nacevski, ISBN 978-9989-9571-6-1;	-

Abstract:

Present paper deals with electro-chemical investigation of the corrosion behavior of laser melted surface layers of austenitic stainless steel in physiological solution.

The samples were made of Ch18N10T GOST (AISI 321, EN X6CrNiTi 18-10) steel and their surface were melted by continuous CO_2 laser. All samples were polished before electro-chemical testing. It was done in Ringer's solution at temperature 37°C using potentiostat "Radelkis" with data acquisition device "Natiomal Instruments" USB-6008. Two tests were conducted: measurement of the open cirquit potential and the anodic polarization curves. The samples' surface was investigated by optical and SEM microscopy and; the EDX analysis was done.

After electro-chemical testing, pitting corrosion was observed on the surface of the all samples – untreated and laser melted layers as well. The open cirquit potential stabilized at about 2 hours after immersion. It varied from +94mV of the initial sample up to +233mV of laser melted layers. The pitting corrosion potential of the laser treated samples was between 505mV and 536mV, which is higher than that of the untreated stainless steel (+348mV).

It was established that the melted surface layers of the stainless steel were free of nonmetallic inclusions. Their microstructure is fine grained and consists of austenite with dendrite morphology and small quantity of delta-ferrite.
The electro-chemical investigation showed increased pitting corrosion resistance of the laser melted layers of austenite stainless steel which is due to the more homogeneous and fine grained microstructure of the surface.

13.	Shtarbakov Vl., ***Dikova Ts.,*** Stavrev D., *Microstructure of Surface Layer of T1 and D2 Steels after Laser Melting*, Advances in Materials and Processing Technologies, Vol. 1, Issue 1-2, 2015, p.124-129, http://dx.doi.org/10.1080/2374068X.2015.1116224	Scopus: Cite score (2019)=1,1 **SJR 2019=0.235**

Abstract:

The aim of this study was to investigate the in-depth structure transformations of the laser-melted layers of the steels mostly used in tool production – T1 and D2 steels. The experiments of laser surface melting of T1 and D2 steels were done with continuous wave CO2 laser (wavelength λ = 10.6 μm). The sample's microstructure was investigated, and the EDX analysis was made by SEM JEOL JMS-35C. Our results show that the microstructural changes of the laser-melted layer of T1

steel were determined by the process of directed crystallisation from the bottom layer to the surface. There is considerable inhomogeneity, followed by the predominantly ongoing process of chemical liquation during crystallisation. Cellular structure, consisting high-carbon martensite and significant amount of retained austenite, prevails in the melted pool bottom. Austenite–carbide eutectic with possible presence of lamellar martensite is situated along the dendrites' boundaries (in inter-dendrite spaces). The austenite–carbide quasieutecticum with carbide-type M6C possesses 'skeletal' morphology in these regions. In the laser melting of D2 steel, the phase transformations in the transition zone (liquid–solid state) were defined by running of reverse eutectic reaction at the places of overheated and partially melted carbide phases. During cooling of these regions, the inhomogeneous melt goes through changes that involve precipitation of oversaturated with carbon and chrome austenite and disperse microquasieutectic with carbides of the M7C3 type.

14.	***Dikova Ts.,*** Tsaneva D., Ilieva M., Panova N., Galunska B., *Investigation of the Electro-Chemical Corrosion of Laser-Melted Layers of Stainless Steel in Artificial Saliva*, Advances in Materials and Processing Technologies, Vol. 1, Issue 1-2, 2015, p.115-123, http://dx.doi.org/10.1080/2374068X.2015.1112175;	Scopus: Cite score (2019)=1,1 **SJR 2019=0.235**

Abstract:

Austenitic stainless steel is one of the materials commonly used for manufacturing of orthodontic appliances and brackets. In this study, samples of AISI 321 (EN X6CrNiTi 18-10) steel in initial condition and after laser surface melting were investigated in artificial saliva with pH 5.6. Two tests were conducted: measurement of open circuit potentials (free potentials) *E*f until reaching steady state potentials *E*ss and potentiodynamic anodic polarisation. The samples' surface was characterised by SEM, and EDX analysis was also done. Small amount of pits were observed on the surface of all samples – untreated and laser-melted layers as well. The steady state potential of the base metal was about +238 mV, while that of the laser-melted layers was approximately 50 mV lower. The pitting potentials *E*pit of the lasertreated samples were lower than those of the untreated stainless steel (+802 mV). It was established that the laser-melted surface layers of stainless steel are more susceptible to pitting corrosion in artificial saliva with higher acidity than those of the base metal.

15.	***Dikova Ts***., Dzhendov D., Bliznakova Kr., Ivanov D., *Application of 3D Printing in Manufacturing of Cast Patterns*, Proceedings / VII-th International Metallurgical Congress, 9-12.06.2016, Ohrid, Macedonia; edited by Sveto Cvetkovski & Goran Načevski.- Skopje: Macedonian union of metallurgists, 2016. - CD-ROM;	-

Abstract:

The aim of the present paper is to review the application of 3D printing technologies for manufacturing of patterns for investment and sand casting. The additive technologies are characterized with building the object by addition of the material layer by layer. They offer a number of advantages over the traditional methods: easy, controllable and relatively quick process; manufacturing of objects with complex geometry; no need of complex tooling equipment; the desired shape, dimensions and properties can be obtained. The possibilities of stereolithography (SLA), fused deposition modelling (FDM), multi jet modeling (MJM) and selective laser sintering (SLS) for manufacturing of polymer patterns for investment and sand casting are discussed. The advantages and the disadvantages of different printing processes are summarized. The geometrical

accuracy and the surface quality of cast patterns, fabricated by different technologies, are compared. It was observed, that the dimensions of all samples printed within the study were smaller than that of the virtual 3D models, irrespective of the printer technology used. Concerning the surface quality - the largest is the surface roughness of the sample created by the FDM printer compared to the SLA and the MJM printers. The correct choice of the technological parameters of the equipment is important for obtaining 3D printed cast patterns with high quality and minimum deformations.

16.	Щербаков В.С., ***Дикова Ц.Д.,*** Ставрев Д.С., *Структурные особености и свойства лазерно наплавленного слоя из никелевого сплава на инструментальной стали ХВ4Ф после термического воздействия.* Металлы, №4, 2017, с. 52-57, УДК 669.14.018.252.5;	Импакт-фактор РИНЦ 2017=1,739

Abstract:

In order to repair molding dies operating in the temperature range up to 1000 ° C, it is necessary to study and use materials that are stable at these temperatures. Nickel-based alloys are suitable for this. The structural state of a nickel alloy layer deposited onto a KhV4F tool steel and then heat treated is investigated. KhV4F tool steel (RF GOST) samples are subjected to laser deposition using a pulsed Nd:YAG laser. A nickel-based material (0.02C–73.8Ni–2.5Nb–19.5Cr–1.9Fe–2.8Mn) is employed for laser deposition. After laser deposition, the samples are subjected to heat treatment at 400°C for 5 h, 600°C for 1 h, 800°C for 1 h, and 1000°C for 1 h. The microstructure, the phase composition, and the microhardness of the deposited layer are studied. The structure of the initial deposited layer has relatively large grains (20–40 μm in size). The morphology is characterized by a cellular–dendritic structure in the transition zone. The following two structural constituents with a characteristic dendritic structure are revealed: a supersaturated nickel-based γ solid solution and a chromium-based bcc α solid solution. In the initial state and after heat treatment, the hardness of the deposited material (210–240 $HV_{0.1}$) is lower than the hardness of the base material (400–440 $HV_{0.1}$). Only after heat treatment at 600°C for 1 h, the hardness increases to 240–250 HV0.1. Structure heredity in the form of a dendritic morphology is observed at temperatures of 400, 600, and 800°C. The following sharp change in the structural state is detected upon heat treatment at 1000°C for 1 h: the dendritic morphology changes into a typical α + γ crystalline structure. The hardness of the base material decreases significantly to 160–180 $HV_{0.1}$. The low hardness of the deposited layer implies the use of the layer material in limited volume to repair the forming surfaces of dies and molds for die casting. However, the high ductility of the deposited layer of the nickel-based material is a prerequisite for a high stability under thermocycling loading conditions.

17.	Shcherbakov V.S., ***Dikova Ts.D.,*** Stavrev D.S. *Structural features and properties of the laser-deposited nickel alloy layer on a KhV4F tool steel after heat treatment*. Russ. Metall. 2017 July;2017(7):585-589. https://doi.org/10.1134/S003602951707014X	Web of Science, Scopus Cite score (2017)=0.3 **SJR 2017=0.203** **IF(2017)=0.21**

Abstract:

The study and application of the materials that are stable in the temperature range up to 1000°C are necessary to repair forming dies operating in this range. Nickel-based alloys can be used for this purpose. The structural state of a nickel alloy layer deposited onto a KhV4F tool steel and then heat treated is investigated. KhV4F tool steel (RF GOST) samples are subjected to laser deposition using

<table>
<tr><td colspan="3">a pulsed Nd:YAG laser. A nickel-based material (0.02C–73.8Ni–2.5Nb–19.5Cr–1.9Fe–2.8Mn) is employed for laser deposition. After laser deposition, the samples are subjected to heat treatment at 400°C for 5 h, 600°C for 1 h, 800°C for 1 h, and 1000°C for 1 h. The microstructure, the phase composition, and the microhardness of the deposited layer are studied. The structure of the initial deposited layer has relatively large grains (20–40 μm in size). The morphology is characterized by a cellular–dendritic structure in the transition zone. The following two structural constituents with a characteristic dendritic structure are revealed: a supersaturated nickel-based γ solid solution and a chromium-based bcc α solid solution. In the initial state and after heat treatment, the hardness of the deposited material (210–240 $HV_{0.1}$) is lower than the hardness of the base material (400–440 $HV_{0.1}$). Only after heat treatment at 600°C for 1 h, the hardness increases to 240–250 HV0.1. Structure heredity in the form of a dendritic morphology is observed at temperatures of 400, 600, and 800°C. The following sharp change in the structural state is detected upon heat treatment at 1000°C for 1 h: the dendritic morphology changes into a typical α + γ crystalline structure. The hardness of the base material decreases significantly to 160–180 $HV_{0.1}$. The low hardness of the deposited layer implies the use of the layer material in limited volume to repair the forming surfaces of dies and molds for die casting. However, the high ductility of the deposited layer of the nickel-based material is a prerequisite for a high stability under thermocycling loading conditions.</td></tr>
<tr><td>18.</td><td>Duran K, Mindivan H, Atapek ŞH, Simov M, Dikova T. Tribological Characterization of Cast and Selective Laser Melted Co-Cr-Mo Alloys under Dry and Wet Conditions. Proceedings of 19^{th} International Metallurgy and Materials Congress IMMC 2018, 25-27 Oct 2018, Istanbul, Turkey; UCTEA Chamber of Metallurgical & Materials Engineers's Training Center; p.1212-1215. ISBN No: 978-605-01-1258-0;</td><td>-</td></tr>
<tr><td colspan="3">Abstract:

Co-Cr-Mo alloys are one of the Ni-free implant alloys and they used as restoration materials in dentistry due to their superior mechanical properties, high corrosion resistance and good biocompatibility. Today, selective laser melting (SLM) technology, one of the addictive manufacturing methods, is preferred in fabricating implant materials in order to enhance the alloy properties. Several studies on SLM processed alloys showed that their fine and homogenous structures exhibited better mechanical, physical and also chemical properties compare to ones produced by conventional cast technologies [1 - 4]. In this study, tribological characterization of cast and SLM processed Co-Cr-Mo alloys under dry and wet conditions were investigated. Cast alloy (Biosil-Degudent) was produced by lost-wax casting method, while SLM processed alloy (Co212-f ASTM F75) was manufactured by SLM 125 machine equipped with continuous Nd:YAG laser. Initially, the microstructural features of the alloys were examined by light optical and scanning electron microscopes. Tribological tests of the cast and SLM processed Co-Cr-Mo alloys were examined with a reciprocating wear tester in normal atmospheric conditions (room temperature and 30–40% humidity) and in an artificial saliva solution. All findings were discussed as a function of microstructural features, frictional and corrosion potential of alloys.</td></tr>
<tr><td>19.</td><td>Dikova T., Nikolova M.P., Yankov E., Vasilev T., 2019. Fractographic Analysis of Cast and Selective Laser Melted Co-Cr Dental Alloys after Porcelain Firing, 13th International Conference</td><td>-</td></tr>
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	on the Mechanical Behaviour of Materials (ICM-13), 11-14 June, RMIT University, Melbourne, Australia (ISBN: 978-1-922016-65-2).	

Abstract:

Selective laser melting (SLM) is an additive manufacturing technique that is designed to produce objects by melting and fusing of metal powder with a laser. As a result, parts with high accuracy, fine-grained microstructure and high mechanical properties are obtained which is a precondition for application of SLM process in dentistry. The aim of the present paper is to investigate the fracture surfaces of Co-Cr dental alloys fabricated by casting and SLM. Different specimens were fabricated by casting and SLM using *Biosil-F* and *Co212-f* alloy, respectively. Two groups of samples – uncoated and coated with porcelain, were investigated by a tensile test. Rockwell tests were done for measuring the hardness before and after porcelain firing. The fracture surfaces were examined by SEM. It was found that heat treatment during porcelain firing has an impact on the microstructure of Co-Cr dental alloys, revealed by the changes in hardness and fracture mechanism. The initial hardness of Co-Cr alloy (39 HRC) was higher than that of the cast (33.4 HRC). Due to different processes running in the microstructure, both alloys followed different changes in hardness values after porcelain firing – a decrease to 36.5 HRC for SLM alloy and an increase to 39.8 HRC for the cast. The difference in morphology of fractured surfaces was determined by the manufacturing technology of both alloys. In both cases, destruction occurred by cleavage or "quasi-cleavage" of plates or facets in certain crystallographic planes. Because of the specific structure of SLM alloy, a number of cracks between the pores accompanied this process.

B) FULL TEXT PUBLICATIONS IN BULGARIAN SCIENTIFIC JOURNALS

1. ***Dikova Ts.,*** Milkov M., *Nanomaterials in Dental Medicine,* Proceedings of the 10th Workshops “Nanoscience & Nanotechnology”, Sofia, edited by E.Balabanova & I.Dragieva, 2009, BAS-NCCNT, p.203-209;

Nanotechnology and nano-materials have become an extremely active field of research over the last decade because of potential applications in areas such as medicine, information technologies, energy storage etc. The unique properties of nanosized particles, which are subject of quantum mechanics, determine the great interest. The main purpose in using of nanotechnologies in dental materials is achieving higher mechanical properties, higher abrasion resistance and less shrinkage of dental composites, improved optical and aesthetic properties of composites and ceramics. Till now the nanotechnologies are used in production of wide range of dental materials: light polymerization composites and their bonding systems, imprint materials, ceramics, coatings for dental implants and bioceramics. The goal of this paper is to make an overview of nanomaterials which are designed for and are in usage in the practice of dental medicine..

2. S. Angelova, ***Ts. Dikova,*** *Applications of Nanomaterials in Medicine,* Nanoscience & Nanotechnology, Sofia, edited by E.Balabanova & I.Dragieva, BAS-NCCNT, Issue 12, 2012, p.162-165;

The term of “nanomedicine” is a highlight of the passing decade, drawing tendencies of researches and scientific approaches in the range of medicine. Structurally-determined properties of nanoparticles make the last perspective tools for improvement and optimization of preventive, diagnostic and therapeutic proceedings in medicine. Nearly the whole range of nanomaterials, wellknown up to now, can be used for medical purposes. Undoubtedly nanotechnologies have their specific role at vaccination procedures, in vivo and in vitro diagnostic methods and drug delivery systems, precisely tissue engineering, biocompatible implants, molecular visualizations, biosensors, biophotonics.

3. ***Dikova Ts.,*** *PERSPECTIVES FOR APPLICATION OF NANOMATERIALS IN MECHANICAL ENGINEERING*, Proceeding of the VI Sci Conf „Machines, technologies, Materials", 18-20 Feb 2009, Sofia, Bulgaria, Volume 3, Materials, p. 7-11;

During the past decade nanostructure materials have been used more and more in different branches of industry, because of their qualitatively new properties they possess. In metallurgy alloys nano-modification following by additional heat and deformation treatment are used for producing of nanostructure materials. The applications of nanomaterials in mechanical engineering are as follows: details and tools made of nano-powders by powder metallurgy, which have several times higher hardness, strength and exploitation properties; construction nanostructure materials produced by severe plastic deformation; nanoparticles coatings for improving the tool life and wear resistance of friction couples; nano-filler composites for developing of new light materials with higher physical-mechanical properties; using of nano-powder in diffusion welding and soldering for decreasing the processes temperature and obtaining solid joints between different materials.

4. ***Dikova Ts.,*** *Main methods for production of nanopowders and bulk nanomaterials for mechanical industry,* Proceeding of the VII Sci Conf „Machines, Technologies, Materials", 26-27 May 2010, Sofia, Bulgaria, Volume 2, Technologies & Management, Materials, p. 8-12;

During the last years a new materials generation enters in the world market to satisfy the more and higher requirements in different branches of mechanical industry – the nanomaterials. They are used in the form of nanopowders, nanolayer coatings, nanostructured bulk materials and nanocomposites. Because of the quite different nanomaterials' properties compared to the volume materials and their huge variety a lot of production methods exist continuously developing.
In the present paper the technologies for producing of nanopowders and bulk nanostructured materials are discussed. The nanopowders are produced by chemical, physical and mechanical methods. The peculiarities, application and development of the mostly used processes are represented: precipitation from colloid solution, thermal decomposition, plasma-chemical and mechano-chemical synthesis.
Two approaches exist for obtaining of bulk nanomaterials – producing from particular nanoparticles and as a result of matrix nanostructuring. Three main methods are used in the practice – compacting of ultrafine powders by powder metallurgy, controlled crystallization of amorphous materials, obtained by melt quenching and severe plastic deformation of materials by equal-channel angular pressing.

5. Angelova S., Georgiev P., Dushkin C., ***Dikova Ts.,*** *Comparison of the optical properties of nanoparticles, synthesized by different chemical methods,* Nanoscience & Nanotechnology, Nanostructured Materials Application and Innovation Transfer, Sofia, edited by E.Balabanova & I.Dragieva, BAS-NCCNT, Issue 11, 2011, p.46-49;

For the sake of their unique characteristics, nanomaterials bear a resemblance to the superficial properties of natural tissues. The nanoparticles sizes vary from 1 to 100 nm, which make them commensurable with the cell structure. Because the materials properties depend on their sizes, the nano-scale species will possess specific mechanical, electric, optical, catalytic and magnetic features in comparison with conventional materials and those in the microscopic range. With plenty of specific properties, the nanoparticles have clearly traced the passing decade and are determining also the trends of large-scale research and achievements in different areas of science.The aim of this paper is to compare the optical properties of nanoparticles, synthesized by different chemical methods: microemulsion synthesis of CdS nanoparticles, hot matrix synthesis of CdSe nanoparticles and citrate synthesis of gold nanoparticles. The presence of semiconductor nanoparticles produced by the microemulsion and hot matrix methods is proven by treating these objects with UV light. "Beaming" of nanoparticles with green-yellowish, for smaller ones, to red, for larger ones, light is observed. The spectral curve is characterized by definitely represented exciton peak. A correlation between the wavelength, corresponding to the absorption maximum (exciton peak) and nanoparticles size does exist. In water suspension, the gold nanoparticles are coloured in red due to the so-called surface plasmon, documented as a peak in the absorbance spectrum. Showing the interdependence between the intensity of absorption maximum and time, kinetics curve of the chemical reaction is obtained.

6. Stavrev D., ***Dikova Ts.,*** Ivanova D., *New technology for in-depth surface hardening by combined induction and gas-flame heating*, Proceeding of the VII Sci Conf „Machines, Technologies, Materials", 26-27 May 2010, Sofia, Bulgaria, Volume 2, Technologies & Management, Materials, p. 27-30;

The results of the technological investigation for hardening of large traversing wheels for mining-metallurgical equipment are presented in this paper. The details' dimensions are: diameter 630-2050 mm, traversing part width (height) 180-190 mm, hardened area of the working surface 6023-21532 cm^2, weight 380-3400 kg. They were made of steel GS 42CrMo49(Q+T), DIN-EN 10290, and they should meet the requirements about hardness of the working surfaces of 50+4 HRC with hardened layer depth (up to 40 HRC) – 18+4 mm.
The test quenching and the investigations are realized in simultaneously using of low frequency generator, inductor with consumed power about 200 kW and air-gas burners (propane-butane) with total power about 1200 kW. The heating was made on the installation with vertical rotation axis in simultaneously power impact on the whole heated working surface. For the wheel with diameter 2050 mm it was carried out by the especially designed inductor and 12 air-gas burners. The inductor was remote with a minimum air windage, while the burners are situated uniformly around the rest periphery part, inclined at angle 30^o towards the tangent in the point of the flame guidance. For reducing the heat losses the heated surface was insulated by a mobile steel mantel with ceramic insulating wadding. The temperature 880^oC was reached on the periphery after heating it in about 50 min with total consumed power about 1400 kW. After that the detail was transported (about a minute) and immersed into a bath with 25% water solution of polymer ZAKALIN-B. For reaching the temperature of the working surfaces 180-200^oC it was cooled for about 8 min. The periphery hardness, measured by EGUTIP 2, was 56-57 HRC. The following tempering was carried out for 5 hours in temperature 280^oC.
On the test sample (first wheel) the control of the hardness in depth was made along the 7 directions. It shows that the surface hardness is 52-50 HRC; the hardness in 15 mm depth is 49-41 HRC, in 20 mm depth - 46-36 HRC and in 25 mm depth - 41-34 HRC. The investigated method allows the high efficiency of the induction heating to be combined with the large power of the gas-flame heating for reaching the effect of the surface hardening in depth and satisfying the quality requirements.

7. Stavrev D., ***Dikova T.,*** *Mechanism and morphology of ferrite transformations under laser and electron beam treatment,* Engineering sciences, XLVII, 2010, No. 2, p.83-90;

Unlike the theory of the classical ferrite-austenitic transformation, which treats it as diffusion-concentration-thermal, under the influence of concentrated energy fluxes (CEF) it could not be defined as such. The main reason is the significant kinetics of thermal fields and their inhomogeneity in space. The changes in the ferrite are of particular interest. In the present paper, the changes of the ferrite phase of Fe-C alloys under the conditions of surface treatment with concentrated energy fluxes, laser and electron beam are formulated and experimentally proved. The transformation of ferrite to austenite in heating is predominantly non-diffusion. This is due to the specific energy conditions of high-speed temperature rise, a combination of high internal stresses and inhomogeneity of the thermal fields. The austenite formed is highly inhomogeneous and deformed. It inherits ferrite subdefects, which also affects the resulting phases in the next cooling step. The hypothesis of non-diffusion, rather deformation transformation of ferrite into austenite is confirmed. Therefore, the resulting austenite is thermodynamically unstable. In the cooling stage, an "inverse" austenite-ferrite transformation was observed and a mosaic modified ferrite with a block orientation of the mosaic formations was obtained. The processes along the boundaries of ferrite and other structural components, cementite and graphite, are also considered. In principle, ferrite is enriched in carbon, which depends on the orientation of the grains in the direction of thermal fields.Migration of carbon from graphite into ferritic (austenitic) grains is observed with subsequent conversion to martensite. Graphite can reduce its volume as well as to dissolve completely in the surrounding ferrite. After cooling, imbalance structural components occur.

8. ***Dikova Ts.,*** D. Stavrev, B. Misra, K. Venkadeshwaran, D. Misra, *Dimensions Accuracy in Different Laser Cutting Schemes,* Int. Journal “Machines, technologies, Materials”, Issue 11/2011, p.15-18;

This work aims to investigate the dimensions’ accuracy in different schemes of laser beam movement during the laser cutting process. Samples with different thickness were made of DC01 EN 10130 steel. On each sample 32 round holes were cut in 4 rows by different laser beam movement schemes – linear, zig-zag and random. The tests were made by pulse CO2 laser with regimes, recommended for each sheet thickness, by the machine operating manual. The diameters along the laser head and the table axes were measured by a projector. The varying intervals of the dimensions and the maximal ellipticity were calculated. In the all three cutting schemes the varying intervals of the diameters D1 and D2 are commensurable. They are in the range of 0,020–0,095mm for D1 and 0,030-0,110mm for D2 whereas the larger values assign to the samples of higher thickness. The maximal ellipticity, mainly due to the laser beam polarization, is in the range of 0,070mm-0,210mm, increasing with the sheet thickness rising. Consequently, different schemes of laser cutting do not influence significantly on the diameters values. The precision of the machine driving mechanisms, process parameters and material properties exert more significant effect on the dimensions accuracy.

9. ***Dikova Ts.,*** N. Panova, M. Simov, *Application of Laser Technologies in Dental Prosthetics*, Int. Journal “Machines, Technologies, Materials”, Issue 6/2011, p.32-35;

Laser technologies are widely used in various areas of contemporary practice - not only in engineering but also in medicine. Owing to them, more accurate and precise results are achieved in making objects of unique shape and size for various purposes. In recent years, these technologies have entered rapidly into dental prosthetics. Several processes are mainly used: laser cutting, laser welding, laser sintering, rapid prototyping, laser cladding and laser surface structuring. Laser cutting and laser welding are mainly used in dental laboratories for production of large bridge prostheses ensuring high construction accuracy. By laser sintering and laser prototyping, individual crowns, dentures and implants are made from 3D models for each patient. Laser cladding and laser nanostructuring are used for surface treatment of implants to enhance their biocompatibility and osteoblast integration.

10. Ivanova E., ***Dikova T.,*** *Main operations for working with the program "AutoCAD".* Marine Science Forum. Volume 3. Ship energy. Mechanics. Ship repair. „N.Y. Vaptsarov" Naval Academy, Varna, 2011, p. 112-117.

Knowledge of AutoCAD operations and techniques in drawing and design gives an opportunity for esy and accurately visualizing of the nessesary details in images, views, sections and others.

11. Ivanova E., ***Dikova T.,*** *Application of the program "AutoCAD" in drawing.* Marine Science Forum. Volume 3. Ship energy. Mechanics. Ship repair. „N.Y. Vaptsarov" Naval Academy, Varna, 2011, p. 118-122.

The aim of this work is to teach students how to put into practice the basic AutoCAD commands for drawing and editing. Using of the software will help the designers quickly and easily to visualize the technical objects.

12. Stavrev D., ***Ts. Dikova****, Corrosion of Cr-Mn-Ni Heat-Resistant Steel under Thermocyclic and Mechanical Impact in Furnace Media,* Int. Journal "Machines, Technologies, Materials", Issue 1/2012, p.25-28;

This research aims investigation of the structural changes of austenite-ferrite steel 105MA (1.4892) subjected to the exploitation impact in the cement furnace. The chains were made of the investigated steel, working in the furnace high temperature zone. Their function is to transport and dry up the technological slurry (37% water) in temperatures 600-900oC. The frequency of the thermal and mechanical loading cycles of the chains corresponds to the furnace rotation velocity of 1,3 oscillations per minute. At the end of the exploitation period (2880 hours continuous work) the technological regime's aberrations was established: the gases temperature reaches 1050oC, while the water in slurry was 55%. The macro- and microstructural analysis shows decreasing of the chains segments' cross sections with about 30% due to the corrosion and the slurry mechanical influence. The initial austenite structure contains ferrite-carbide streaks uniformly distributed along the grains boundaries. As a result of the heat impact with the temperature amplitude above 700oC the structure undergoes recrystallization transformations. The troostite zones decrease because of the increasing the alpha, sigma and carbide phases quantity. The active corrosion begins with pit character. Its development is intercrystalyne, attacking at first the phases mentioned above. This process is followed by corrosion-fatigue cracks which branch out in their tip and propagate transcrystalyne. They grow mainly along the chain segments' axes in correspondence with the tensile cyclic mechanical loading. The opened cracks fill with the corrosion products and slurry thus accelerating their propagation in thermo-cyclic loading leading to the totally chains destroying.

13. Simov M., Jendov J., Marinov N., Pavlova D., Sofronov Y., ***Dikova Ts.*** , Todorov G., Kalachev Y.*, Изработване на дублажни модели за неподвижни протезни конструкции*, Научни известия, НТСМ, 2(151) 2014, стр.75-79;

Present paper deals with the possibilities of multiple manufacturing of 4-parts dental bridges using wax models produced by two different techniques: silicon key and rapid prototyping. The first bridge was made of Co-Cr alloy by the standard lost-wax technology. It was used for manufacturing of silicon key and 3D model. Five wax models were produced manually using silicon key, which then were used for casting of 5 bridges. The 3D model was incorporated into the software of the prototyping machine for manufacturing of 6 Indura Cast wax models. They were used for casting of bridges by lost-wax technology. The elements of the all samples were measured and their accuracy was estimated. The average sizes and maximum size's deviation were calculated. The deviations of the sizes of joints 0,3-0,7mm and of the bridge bodies 1,04-1,54mm in silicon key technique show that the bridges produced by this method have lower accuracy than that produced by Indura Cast wax prototypes.

14. Katreva I, ***Dikova T***, Abadzhiev M, Tonchev T., Dzhendov D, Simov M, Angelova S, Pavlova D, Doychinova M., *3D-Printing in Contemporary Prosthodontic Treatment*, Scripta Scientifica Medicinae Dentalis, Vol. 2, No 1, 2016, p. 16-20;

The purpose of the present paper is to make a review of the applications for 3D-printing in contemporary prosthetic treatment as this modern technology has become widely spread not only in the industry but in medicine and dentistry, too. It is a form of additive manufacturing technology where a three-dimensional object is created by laying down successive layers of material.

15. ***Dikova T,*** Simov M, Angelova S, Toncheva S. *The profession of dental technician in the modern conditions.* In Варненски медицински форум (Varna Medical Forum) 2016 Jun 1 (Vol. 5, No. 2).

The aim of the present paper is to analyze the profession of dental technician in the modern conditions and technological development. During the last 30 years the technologies for production of dental constructions underwent fast development, which is expressed in three main directions: digitalization, simulation and implementation of the additive technologies. In dental laboratories all these changes led to: 1. radical change in the profession of dental technician - reduce manual labor in manufacturing of dental construction to a minimum, transition to CAD-CAM production, increase the computer skills and qualification of the dental technicians; 2. radical change in the work and relationships of the team dentist - dental assistant - dental technician; 3. world globalization of the health services in dentistry and „health tourism", which have positive effect and help to create clinics and dental laboratories with specialists and equipment of high European and global level.

16. ***Dikova T,*** *Factors influencing the quality of Co-Cr dental alloys cast with 3D printed patterns*. Foundry 2017;1(1):58-62;

The aim of the present paper is to study the factors, influencing on the quality of Co-Cr dental alloys, cast using 3D printed patterns. Three groups of factors are discussed: the properties of the materials for 3D printing, the special features of the 3D printing process and the peculiarities of the casting. As mainly polymers are used for 3D printing of cast patterns, the right material should be chosen, which burn without residue and have no thermal expansion. The main disadvantage of 3D printed patterns is their higher roughness, which depends on the type of 3D printing process, position of the objects towards the print direction and the layers thickness. In order to obtain castings with smooth surfaces, it is necessary to use cast patterns made by stereolithography with the possible minimum thickness of the layer. Each type of 3D printer uses a specific polymer type, therefore it is necessary the investment material to be selected depending on the polymer type. The heating regime of the casting mold is determined by the type of investment material and the alloy to be cast. To obtain a quality casting, all these dependencies must be strictly observed.

17. Pavlova D, Angelova S, Velikova V, Katreva I, Dzhendov D, Simov M, Abadzhiev M, Tonchev T, ***Dikova T***. Investigation of the Dental Technicians' Readiness to Manufacture Dental Prostheses Using Digital Technologies. Scripta Scientifica Medicinae Dentalis, 2018;4(1):25-27;

INTRODUCTION: Modern digital technologies allow us to generate a virtual model of the patient and to design his/her smile. The future definitely belongs to the digital technologies because they offer a reliable, predictable and highly esthetic manner of treatment.
AIM: The aim of the present study is to investigate the dental technicians' readiness to manufacture dental prostheses using digital technologies.
MATERIALS AND METHODS: A total of 159 respondents - practicing dental technicians and students - were surveyed using an online survey. The survey was conducted via a social network platform. Results were processed with SPSS v. 20 using variational, comparative and correlation analyses.
RESULTS: Over 50% of the respondents have indicated that they use different types of digital technologies in their practice, the main reason being that the construction time is shortened and that the accuracy is improved (85.20%). There is a correlation between the length work experience and the use of new technologies ($p<0.05$), with younger specialists being the ones who primarily use modern technology. Young specialists are willing to invest in the purchase of modern equipment and to attend additional courses on working with it.
CONCLUSION: Despite the variety of methods for recreating the prosthetic field when manufacturing prosthetic constructions, a trend towards full digitalization of the process is observed.

18. Georgiev G., ***Dikova Ts.,*** Panov Vl., *Development of Devices for Photo polymerization of Dental Composites*, Proceedings of the Vth International Scientific Conference "Materials Science. Nonequilibrium Phase Transphormations", 09-12.09.2019, Varna, Bulgaria, STUME – Bulgaria, ISSN 2535-0218 (print), ISSN 2536-0226 (online);

One of the most significant current discussions in dentistry is the great variety of devices used for light curing of dental composites. It is possible to assess the benefits of light polymerization only if we look at them historically. The aim of this study is to examine the devices used for light curing of dental composites, to compare them and to reveal the most efficient one. This paper begins by the first devices, which use ultraviolet light. It then goes on to the second stage of their development, which includes quartz-tungsten halogen light curing units, plasma-arc light curing units and the argon-ion laser. Modern devices are LED light curing units. They have many advantages, such as high output power, compact and wireless models with long-lasting battery life, affordable price, little heat generation, etc. Because of this and practically the lack of disadvantages, third generation LED light curing units have been established as the most reliable, preferred and used by dentists all over the world.

19. Georgiev G., ***Dikova Ts.,*** Panov Vl., *INVESTIGATION OF LIGHT INTENSITY OF WIRELESS LED LIGHT CURING UNITS*, Journal of the Technical University of Gabrovo 60 (2020) 40-45, ISSN 1310-6686;

In recent years, LED light curing units (LCUs) have become the main source of light for the polymerization of resin based composites (RBCs). Various factors can affect the normal functioning of LCUs, one of which is the battery charge of the wireless models. The aim of this study is to evaluate the stability of the light intensity of different brands of wireless LED LCUs by measuring it from a fully charged to a fully discharged battery. For this purpose 10 new different fully-charged wireless LED LCUs are used. Light intensity is measured with a digital radiometer. For each unit, the number of curing cycles of 20 s until full battery drop is determined as well as the change in light intensity with increasing the number of cycles (N) and decreasing the battery life (%). It has been found that for some devices (LY-C240, SK-L029A, CV-215, OSA-F686C, Xlite4, D-Light Duo) the light intensity is lower than specified by the manufacturer, which may cause incorrect determining of the optimal polymerization time. In six of the examined models - Bluephase N, D-Light Duo, LY-C240, Demi Plus, I-LED 2500 and Elipar Deep Cure S, the light intensity is stable and independent of the battery life. In the other devices (SK-L029A, CV-215, Xlite4, OSA-F686C), the battery discharge causes a decrease in light intensity. It can be concluded that dentists have to periodically measure the light intensity of their LCUs and regularly recharge them, especially in battery-dependent models.

20. ***Dikova T.,*** Kulinich S.A., Iwamori S., Tei K., Yamaguchi S. *Investigation Surface Morphology of CP Ti and Ti6Al4V Alloy Treated with Picosecond Laser*, Journal of the Technical University of Gabrovo 59 (2019) 5-11, ISSN 1310-6686;

The aim of the present paper is to investigate the morphology of titanium surfaces treated with picosecond laser. Round samples of cpTi Gr-2 and Ti6Al4V alloy were treated by a commercial picosecond laser. Two variables were used: average power (1W, 0.5W, 0.2W) and pulse number (1,000-20,000). The samples were investigated by OM, SEM, EDX and non-contact 3D surface profilometer. It was found that the topography of the laser-treated surfaces of both cpTi Gr-2 and Ti6Al4V alloy was similar. It is characterized with micron-scale periodical structures in radial direction, appearance of cavities, submicron-scale periodical structures in the former grains along the periphery of ablated craters (in low energy regimes) and splashed material and debris along the boundaries of the cavities (in higher energy regimes). The depth of the cavities in cpTi Gr-2 treated with the lowest regime parameters was lower than that of Ti6Al4V alloy (0.4 and 5.5 μm, respectively). In cpTi Gr-2, the cavity depth increased mostly with increase in the pulse number while for Ti6Al4V alloy it increased with increasein laser power. The surface of the zone of laser influence and walls of the cavities were covered with layers of different titanium oxides in cp Ti-Gr-2 and with mixed oxides of Ti and Al in the case of Ti6Al4V alloy. The oxides along the cavities walls were characterized with layered morphology, which is finer in Ti6Al4V alloy. The results of this study can be used when applying picosecond pulsed lasers for texturing titanium surfaces to improve their medico-biological properties.

21. ***Dikova Ts.,*** *Technological Features in Fabrication of Co-Cr Dental Alloy by Selective Laser Melting*, Journal of the Technical University of Gabrovo 60 (2020) 34-39, ISSN 1310-6686;

The process of selective laser melting (SLM) is an alternative to the conventional technologies and can be used to solve many of their problems. During SLM process, an object is produced directly from a virtual 3D model by melting a metal powder layer by layer using a laser. Incorrectly selected process parameters can lead to defects decreasing the details quality.
The purpose of the present paper is to analyze the peculiarities of the production of dental Co-Cr alloy by SLM method and to propose technological regimes for manufacturing of fixed partial dentures with high density. Four-component dental bridges are used as samples, which are made of Co212-f ASTM F75 alloy using SLM 125 machine. The accuracy and structure of the specimens

are investigated by OM and SEM. The influence of technological parameters of the SLM process on the quality of the details is analyzed.

It is found that in order to ensure high accuracy of the constructions, it is necessary to make changes in the dimensions at the stage of the virtual model, as the corrections are the same on all axes. Optimal technological parameters - laser power and scanning speed are calculated and proposed, which provide a dense structure and high mechanical properties of the details, manufactured of Co-Cr dental alloy by SLM method with the equipment used. The results of this study will be useful for successful implementation of the SLM equipment in dentistry for production of high quality Co-Cr constructions.

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