

To the Chairman of the Scientific Jury,

Designated by Order No. P-109-132 / 01.04.2024

Medical University "Prof. Dr. Paraskev Stoyanov" - Varna,

REVIEW

on the procedure for obtaining the PhD degree

in the doctoral programme "Medical Physics", professional area 4.1. Physical Sciences

PhD Thesis

Scientific speciality: Medical Physics

Author: Natalina Konstantinova Panova

Form of doctoral study: full-time

Department: Physics and Biophysics

Topic: CORROSION RESISTANCE IN BIOLOGICAL FLUIDS OF AISI 321 AUSTENITIC
STEEL AFTER LASER INFLUENCE

Scientific supervisors: Prof. Tsanka Dimitrova Dikova, PhD, DSc

Prof. Krastena Todorova Nikolova, PhD

Reviewer: Prof. Plamen Ivanov Zagorchev, PhD, DSc

Scientific Specialty: "Biophysics", Department of Medical Physics and Biophysics,
Medical University of Plovdiv

Address: 15A Vasil Aprilov blvd, Department of Medical Physics and Biophysics,
Medical University of Plovdiv

1. General presentation of the procedure and the PhD student

The submitted set of materials on paper and electronic media is in accordance with the Procedure for Acquisition of the PhD degree at MU "Prof. Dr. Paraskev Stoyanov" - Varna, the Regulations for the Development of Academic Staff and includes the following documents:

- application to the Rector of MU "Prof. Dr. Paraskev Stoyanov" - Varna for the opening of the procedure for the defense of a dissertation.
- curriculum vitae with the doctoral student's signature
- a notarised copy of a diploma of higher education
- orders for enrolment in a doctoral programme and for dismissal with the right of defence
- an order for an examination from the individual plan and a corresponding protocol for passing the examination or the doctoral minimum in the specialty
- the protocol from the departmental council for the preliminary discussion of the dissertation and the decisions taken for the granting of the right to defence, for the opening of the procedure and for the members of the scientific jury
- dissertation
- abstract
- list of scientific publications on the subject of the thesis
- copies of the scientific publications
- list of participations in scientific forums
- declaration of originality and authenticity of the attached documents

2. Brief biographical data about the PhD student

Natalina Panova defended her Master's degree at the Shumen University "Bishop Konstantin Preslavsky" in 2000. Since 2001 she has been an assistant professor at the Medical University "Prof. Dr. Paraskev Stoyanov" - Varna. In November 2020 she was enrolled as a full-time PhD student and was dismissed with the right to defend in March 2024. She is fluent in English.

3. Relevance of the subject matter and appropriateness of the set goals and objectives

The literature data testify to the relevance of the developed topic, namely the modulation of surface parameters of customized implants and structures by laser cutting, welding and heat treatment technologies.

The positioning of the GOAL and the OBJECTIVES in the middle of the thesis follows the literature review and is logically related to the conclusions on pages 55-57.

The tasks (p. 58) are sufficient in number and are feasible. What I find unacceptable is that in the aim and objectives laser and laser-melt layers are written 5 times without specifying the type of laser source.

4. Knowledge of the problem

The overview is extensive from the 10th to the 55th page. It includes three chapters: 1. APPLICATION OF LASERS AND LASER TECHNOLOGY IN MODERN DENTISTRY, 2. STAINLESS STEELS FOR BIOMEDICAL APPLICATIONS, and 3. CORROSION OF STAINLESS STEELS and contains 20 figures, 2 tables and 8 formulae. I believe that the quality of the dissertation would be enhanced after unification in following the pattern of the text in Figure 1-12. on page 38. This would also make the author's figures such as Figs. 1-5 and probably Figs. 1-6 stand out clearly.

In the dissertation I find citations to a total of 180 sources. The publications cited are up-to-date, as evidenced by the following - the number of studies published since the beginning of 2020 is 28, which is 16% of all sources used, and their quality is adequate to the topic of the dissertation. The review ends with a final summary in the form of eight conclusions which is a good model to follow.

5. Research methodology

From the defined objective, four groups of tasks are derived to investigate CO₂ laser melted layers of AISI 321 austenitic steel. They are limited to the study of:

1. the microstructure of the surface after melting.
2. the corrosion resistance in Ringer's solution.
3. the corrosion degradation of the steel layers in Ringer's saline solution.
4. the corrosion of laser-melted steel layers in artificial saliva.

In chapter two "MATERIALS AND METHODS" within 9 pages is presented 1. 2. MATERIAL AND METHODS OF SPECIMEN FABRICATION; 3. CORROSION STUDY; AND 4. CHARACTERISATION OF THE SPECIMENS. The chapter contains 4 tables and 4 figures. Regarding the figures and tables, I believe that they are the author's work and illustrate the experimental protocols well as Table 2-2 needs to specify the type of laser and specify the number of samples of each specimen (0, 1, 4 and 6), and in Table 2-3 it is necessary to follow the Bulgarian standard (BDS) when presenting decimal fractions. I believe that in presenting the research apparatus everywhere it should be like the description of CEM made on page 67.

6. Characteristics and evaluation of the thesis

The results are many and are a prerequisite for the conclusions drawn. They are presented in 36 figures, some of which include a tabular section. The main results are on laser modification of the samples studied and are informative. For example, the melting of the specimens with a CO₂ laser:

- preserves the biphasic microstructure and homogenizes it in morphology;
- does not lead to significant changes in the corrosion behaviour of AISI 321 austenitic steel;
- pitting and crevice corrosion are observed;
- increases the pitting potential of Epit relative to the base metal potential, etc.;
- the main mechanism of corrosion degradation in austenitic AISI 321 stainless steel is identical to that of the untreated sample - selective destruction of the corrosion-resistant δ -ferrite phase in the form of pitting.

The acidity of the medium (artificial saliva with pH 6.5 and pH 5.6) does not change the type of corrosion - pitting and crevice. The formed pitting is relatively small, and its number is higher in laser-treated samples compared to those of the base metal.

7. Contributions and Significance for the Development for Science and Practice

The conclusions and contributions are well formulated and are significant in number. In my opinion, grouping them together would accentuate their relevance to science and to patient care. In this regard, I admire the formulation of conclusion number 12.

As a merit of the development, I can point out:

- The experimentally found increased resistance to pitting corrosion in Ringer's solution in laser melted layers compared to untreated ones.

- The laser-melted layers show a lower resistance to pitting corrosion at elevated acidity (pH 5.6), a fact that both dentists and dental technicians must consider.

8. Evaluation of the publications on the thesis

It is based on 4 scientific articles, 2 of which are in Q3 journals.

9. Personal involvement of the PhD student

My assessment of the PhD student's personal involvement in the research is based entirely on the materials provided. Asst. prof. Panova is the lead author in one of the publications. The papers presented are the work of a team of four researchers and this suggests that the acquisition, processing and presentation of the data obtained is primarily a personal achievement of the PhD student.

10. Critical comments and recommendations

I have no significant critical comments or recommendations on the way the research was conducted, or the set of materials provided. The correct literary Bulgarian language in which the dissertation is written makes an excellent impression. A minor omission is that some abbreviations do not appear in the list of Latin abbreviations. I must outline the lack of description of the statistical methods used. In some of the figures e.g. such as (Fig. 4-3), I find typical statistical parameters evidence of statistical analysis conducted.

11. Personal impressions

I do not know asst. prof. Panova. I judge about her entirely on the materials provided to me - doctoral thesis, abstract, scientific publications, etc.

CONCLUSION

The dissertation work contains scientific and applied results, which have scientific contribution and meet the requirements of the Law on the Development of Academic Staff in the Republic of Bulgaria.

The dissertation proves that Natalina Panova possesses theoretical knowledge and practical skills for independent scientific research as well as skills for presentation of the obtained data, their analysis and publication.

The materials and results presented in the dissertation fully meet the specific requirements at Medical University - Varna. This gives me a reason to vote "for" at the meeting of the scientific jury and to recommend to the Faculty Council at the Faculty of Pharmacy at Medical University - "Prof. Dr. Paraskev Stoyanov" Varna the award of the educational and scientific degree "Doctor" to Natalina Panova.

10. 05. 2024

Plovdiv

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§1, б. „В“ от Регламент (ЕС)
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/Prof. Plamen Zagorchev, PhD, DSc/