

REVIEW

by: Prof. Nayden Chivarov, Ph. D.
concerning: educational and scientific degree "doctor"

Author of the dissertation:

MSc Eng. Gabriela Viktorova Kotseva

Title of the dissertation:

„MECHANICAL AND TRIBOLOGICAL STUDIES OF
POLYMERS AND COMPOSITES PRODUCED BY 3D
PRINTING“

Professional field:

5.2. „Electrical Engineering, Electronics
and automation“

Doctoral program:

„Automated systems for information
processing and control“

Academic Supervisor:

Prof. Nikolay Stoimenov, Ph. D.

1. Assessment for compliance with the minimum national requirements.

Съгласно Pursuant to Order No. 302/28.11.2025 of the Director of the Institute of Information and Communication Technologies at the Bulgarian Academy of Sciences (IICT-BAS), I have been appointed as a member of the scientific jury for the evaluation of a dissertation entitled "Mechanical and Tribological Studies of Polymers and Composites Produced by 3D Printing," authored by Assist. MSc Eng. Gabriela Viktorova Kotseva.

As a reviewer, I have received the following materials:

- An application to the Head of department;
- The dissertation thesis for the educational scientific position of the Doctoral Degree (PhD);
- A declaration of originality;
- The abstract of the dissertation in Bulgarian and English;
- A list of publications related to the dissertation;
- Full-text copies of six publications related to the dissertation;
- A report on the fulfillment of the minimum requirements of IICT for the Doctoral Degree;
- An opinion of a habilitated expert;
- A similarity report generated by StrikePlagiarizm.

The dissertation submitted to me for review meets the requirements of Article 6(2) of the Law on the Development of the Academic Staff of the Republic of Bulgaria (LDASRB) and Article 27 of the Regulations for the implementation of the law on the development of the academic staff of the Republic of Bulgaria (RILDASRB). This gives me reason to believe that the minimum required 50 points for group of indicators A for the doctoral degree in Table 1 of the Annex to Article 1a, paragraph 1 of the Regulations for the Implementation of the Higher Education Act for the field of higher education 5. Technical Sciences, professional field 5.2. Electrical Engineering, Electronics, and Automation. The information provided to me on the fulfillment of the minimum requirements of the IICT-BAS for the doctoral degree correctly

reflects which indicators from group G are the publications related to the dissertation. This gives me grounds to award 66.64 points under indicator group G, which exceeds the minimum requirements for the doctoral degree in Table 1 of the Annex to Article 1a, paragraph 1 of the RILDASRB for the field of higher education 5. Technical sciences, professional field 5.2. Electrical engineering, electronics, and automation.

As the chairman of the scientific jury, I have not received a written report of plagiarism or unreliability of the scientific data presented in the dissertation within the meaning of Art. 4, para. 11 of the LDASRB.

In accordance with Art. 2, para. 1 of the LDASRB, I accept the dissertation submitted to me and the publications on it for review.

2. Structure and content of the dissertation.

The dissertation is 175 pages long and consists of an Introduction, 5 chapters, a Conclusion, Contributions, Bibliography, Declaration of Originality, List of Publications Related to the Dissertation, and Appendices. It contains 80 figures and 23 tables, distributed across 4 chapters.

3. Actuality of the problem regarded in the dissertation.

The objective set out in the dissertation under discussion outlines a significant problem with regard to the tribological properties of 3D-printed parts, a topic which is discussed therein. The dissertation is situated within a contemporary research domain that finds application in the field of three-dimensional technologies, with a particular emphasis on composite materials. A detailed analysis of tribology as a scientific discipline has been conducted, and the characteristics of the created 3D-printed parts have been experimentally determined. The necessity for research in this field is evidenced by the wide range of characteristics and parameters associated with 3D printing, which can result in varying indicators depending on the specific application requirements.

4. Degree of knowledge of the problem state.

The dissertation's structure, encompassing a comprehensive literature review of 226 bibliographic sources, including websites, a detailed historical background, and a description of the methods used, attests to the author's profound understanding of the subject matter. The objectives and tasks of the dissertation are formulated in a cogent manner following an in-depth analysis.

5. Correspondence of the goal and tasks with the achieved results in the dissertation.

The primary objective of the present dissertation is to ascertain the mechanical and tribological properties of polymers and composites obtained by 3D printing.

The following tasks have been assigned to achieve this objective:

1. The following review and analysis will examine tribological processes, technologies and devices for obtaining polymers and composites. In addition, the review will address the methods for investigating the physical-mechanical and tribological properties of polymers obtained by 3D printing.

2. The objective of this study is to develop principles and approaches for investigating the physical-mechanical and tribological properties of polymers with 3D printing.

3. The objective of this study is to analyse the microhardness and wear characteristics of 3D materials.
4. The analysis should encompass sliding friction, rolling friction, and the coefficient of recovery.
5. The execution of simulation studies of three-dimensional printed samples is to be undertaken with the utilisation of EDEM Software.
6. The recovery coefficient should be simulated.
7. It is proposed that a comprehensive approach be adopted for the characterisation of the 3D printers utilised.
8. The execution and analysis of experimental studies is imperative.

The tasks set in the dissertation correspond to the defined objective. The approaches employed in this study evince a profound comprehension of the subject matter. The results obtained demonstrate that all tasks have been completed, thereby achieving the objective set out in the dissertation.

6. Characteristics of the dissertation

The first chapter provides an overview and analysis of tribology as a science and engineering discipline. The historical development of the subject on a global scale, as well as its significance in Bulgaria, is given due attention. The mechanical, chemical and physical properties of the material are examined. A detailed analysis of the various types of wear is conducted, with particular emphasis placed on the intricacies of 3D printing technologies, materials, and their inherent properties.

Chapter 2 presents a range of methods for the study of tribology in relation to polymers and composites. The experimental devices utilised for the research are examined.

Chapter 3 presents the methods employed in the study of the physical-mechanical and tribological properties of 3D-printed polymers and composites. A range of methodologies for working with simulation software that provides process modelling has been developed.

Chapter 4 presents the findings from experimental studies conducted on 3D-printed materials. The data obtained includes analyses of recovery coefficients and results from simulations using specialised software. A range of materials and parameters have been analysed in order to establish the influence on tribological characteristics.

Chapter 5, which delineates the subsequent steps for the development of the dissertation and the doctoral student, is commendable. The experimental results obtained in the dissertation provide scope for further research to improve the details of 3D printing.

7. Scientific, and scientific-applied contributions of the dissertation.

The contributions formulated by the author are accepted and evaluated positively. In summary, the following classification system can be proposed:

1. A classification of tribological processes has been formulated and presented in schematic form.
2. Methodologies have been developed for the purpose of investigating the tribological properties of 3D-printed materials. In addition to this, methods have been developed for the analysis of mechanical properties and microhardness.
3. A comparative analysis between experimental data and simulations has been conducted.

4. Research on the technological parameters of 3D printing, with an emphasis on sample geometry, layer thickness, printing orientation, and material composition, has a significant impact on mechanical and tribological properties.

5. Approaches for the utilisation of recycled and biodegradable polymers have been developed.

8. Evaluation of the dissertation publications.

The dissertation comprises seven published papers. It is noteworthy that in five of the publications, Mag. Eng. Kotsova is the primary author. The publications have been featured in a number of prestigious international conferences, including those with an SJR rank of three in the field of international scientific and technical conferences, and four in the field of scientific and technical conferences abroad. The publications thus reflect the key results from the dissertation. The degree of activity in terms of publications serves as an indicator of the relevance of the subject matter.

9. Opinion, recommendations and remarks.

I have no critical comments regarding the doctoral student. There are technical errors and a lack of bibliography for some figures. Recommendations for future work include increasing publication activity in refereed journals.

10. Assessment of compliance of the summary to the requirements.

The abstract fully complies with the requirements of the LDASRB and IICT-BAS in terms of format, length, content, and presentation of the results achieved. It reflects the key activities, the results obtained, as well as the conclusions and contributions in the dissertation.

11. Personal impressions of the candidate for educational and scientific degree "doctor".

I have had the privilege of becoming personally acquainted with PhD student Gabriela Kotseva since she commenced her employment at IICT-BAS. It is evident that, over the years, she has demonstrated her commitment to research, consistently demonstrating readiness to confront the challenges that have been presented to her, completing them in a timely manner and with the requisite attention to detail. Evidence of her dedication to scientific research and the outcomes of her endeavours are manifest in her receipt of the esteemed BAS award for the most promising young scientist, "Ivan Evstratieff Geshov," in 2025.

CONCLUSION

It is this researcher's conclusion, based on the dissertation presented to me and the materials submitted with it, the educational objectives of the doctoral programme, and the relevance and significance of the scientific and applied contributions achieved, that the dissertation work of Mag. is to be assessed as POSITIVE. Eng. The name of the person under discussion is Gabriela Viktorova Kotsova.

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Date: 26.01.2026

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