UNIVERSITY OF BELGRADE
TECHNICAL FACULTY IN BOR

# BOOK OF ABSTRACTS

## 8th INTERNATIONAL STUDENT CONFERENCE ON TECHNICAL SCIENCES

www.tfbor.bg.ac.rs

ISC 2023

8th INTERNATIONAL STUDENT CONFERENCE on Technical Sciences

*20-21 October, Bor Lake, Serbia*

Editor: Uroš Stamenković

**Book of Abstracts,**
*8th International Student Conference on Technical Sciences ISC 2023*

**Editor:**
**Doc. dr Uroš Stamenković**
University of Belgrade - Technical Faculty in Bor

**Technical Editors:**
**Milan Nedeljković, dipl. ing.**
**Avram Kovačević, dipl. ing.**
*University of Belgrade - Technical Faculty in Bor*

**Publisher:** *University of Belgrade - Technical Faculty in Bor*
**For the publisher:** *Dean, Prof. dr Dejan Tanikić*
**Circulation: 50 copies**
**Year of publication:** *2023*

Printed by "*GRAFIKA GALEB DOO" NIŠ, 2023*

**ISBN 978-86-6305-141-6**

CIP - Каталогизација у публикацији Народна библиотека Србије, Београд

622(048)
669(048)
66(048)
66.017/.018(048)

INTERNATIONAL Student Conference on Technical Sciences (8 ; 2023 ; Borsko jezero)
Book of abstracts / 8th International Student Conference on Technical Sciences ISC 2023, 20-21 October, Bor Lake, Serbia ; [organized by University of Belgrade, Technical Faculty in Bor] ; editor Uroš Stamenković. - Bor : University of Belgrade, Technical Faculty, 2023 (Niš : Grafika Galeb). - VII, 51 str. ; 24 cm

Tiraž 50. - Bibliografija uz većinu apstrakata.

ISBN 978-86-6305-141-6

a) Рударство -- Апстракти b) Металургија -- Апстракти v) Хемијска технологија -- Апстракти g) Технички материјали -- Апстракти

COBISS.SR-ID 126594825

# 8th International Student Conference on Technical Science, ISC 2023.

Is organized by

## UNIVERSITY OF BELGRADE, TECHNICAL FACULTY IN BOR

and co-organized by

**University of Zenica, Faculty of engineering and natural sciences, Zenica, Bosnia and Herzegovina**

**University in Priština, Faculty of Technical Science, Kosovska Mitrovica,
Serbia;**

**University of Montenegro, Faculty of Metallurgy and Technology, Podgorica, Montenegro;**

**University of Tuzla, Faculty of Technology, Tuzla, Bosnia and Herzegovina;**

**University of Chemical Technology and Metallurgy, Faculty of Metallurgy and Material Science, Sofia, Bulgaria;**

# INVESTIGATION OF THE EFFECTS OF Ca/P RATIO AND DIFFERENT POLYMER-BASED COATINGS ON THE PROPERTIES OF MACROPOROUS CALCIUM PHOSPHATE MATERIALS

**Student: Olivera Dragutinović**

**Mentors: Đorđe Veljović, Vaso Manojlović**

*University of Belgrade, Faculty of Technology and Metallurgy, Belgrade, Serbia*

**Abstract**

Osteoconductive porous scaffolds coated with different coatings based on biodegradable polymers could be used in bone tissue engineering. A key prerequisite for hard tissue engineering is the design of biocompatible scaffolds that are amenable to the proliferation, differentiation and attachment of osteogenic cells [1]. Hydroxyapatite (HAp) has a structure very similar to biological bone, which makes it an ideal candidate for bone grafts. HAp has properties of biocompatibility, non-toxicity, non-immunogenicity, bioactivity, osteoconductivity, osteoinductivity [2,3]. The goal of the study was to find out how different Ca/P molar ratios and gelatine-based polymer coatings affect the mechanical properties and microstructure of hydroxyapatite-based scaffolds for regrowing bone tissue. Solutions for the synthesis of initial particles of hydroxyapatite (HAp) were formed at Ca/P molar ratios of 1.52 and 1.67. Magnesium, zinc and copper ions were incorporated into both hydroxyapatite powders during synthesis by the hydrothermal method. The precipitated powders were further calcined. Macroporous bioceramic samples obtained by the sponge replica technique (the execution procedure involved applying a paste to the surface of the scaffold obtained by mixing calcined particles, water and polyvinyl alcohol) were sintered at 1370 °C and 1430 °C. The formed bioceramic macroporous samples were further impregnated with different solutions of gelatin, starch and hydroxypropyl methylcellulose, and then frozen and lyophilized or dried at room temperature. In the paper, powders and scaffolds were characterized by energy dispersive spectroscopy, scanning electron microscopy, X-ray diffraction analysis and mechanical characterization. *In vitro* tests of the bioactivity and biodegradability of the obtained materials were performed in a simulated body fluid at 37 °C. Elemental analysis detected dopant ions (magnesium, copper and zinc ions) in the structure of nano-rod particles of hydroxyapatite. Diffractograms of synthesized hydroxyapatite powders showed the presence of hydroxyapatite as a single crystalline phase, while during the thermal treatment of calcination an incomplete phase transformation of HAp into β-tricalcium-phosphate (β-TCP) took place. Diffractograms of macroporous scaffolds obtained at a Ca/P ratio of 1.52 showed the presence of two phases, HAp and dominant β-TCP, while a partial phase transformation to α-TCP occurred in the case of scaffolds with a molar ratio of Ca/P of 1.67. Scaffolds based on hydroxyapatite powder with a molar ratio of Ca/P of 1.52, sintered at 1430 °C, had the highest value of compressive strength. Different biodegradable polymer coatings have initiated additional improvement of the mechanical properties and affected differences in biodegradable properties and bioactivity.

***Keywords:*** *Hydroxyapatite, Polymer coatings, Bone tissue regeneration*

## REFERENCES

[1] V. R. Jokanovic, B. Petrovic, Z. Markovic, Coupling Agents and Biomimetic Methods of Calcium Hydroxyapatites Design as Basic Elements of the Hierarchically Structured Bone Scaffold, Stomatoloski glasnik Srbije, 56(3), (2009), p 130-138.

[2] Dj. Veljovic, T. Matic, T. Stamenic, V. Kojic, S. Dimitrijevic-Brankovic, M. Lukuc, S. Jevtic, Z. Rdovanovic, R. Petrovic, Dj. Janakovic, Mg/Cu co-substituted hydroxyapatite–Biocompatibility, mechanical properties and antimicrobial activity, Ceramics International, 45(17), (2019), p 22029-22039.

[3] S.S.A. Abidi, Q. Murtaza, Hydroxyapatite: Synthesis and Characterization, Journal of Materials Science & Technology, 30(4), (2014), p 307-310.


www.tfbor.bg.ac.rs


8th INTERNATIONAL STUDENT CONFERENCE on Technical Sciences

*20-21 October, Bor Lake, Serbia*

ISBN 978-86-6305-141-6