FIRST INTERNATIONAL CONFERENCE ON ELECTRON MICROSCOPY OF NANOSTRUCTURES

ELMINA 2018

ПРВА МЕЂУНАРОДНА КОНФЕРЕНЦИЈА О ЕЛЕКТРОНСКОЈ МИКРОСКОПИЈИ НАНОСТРУКТУРА

August 27-29, 2018, Belgrade, Serbia
27–29. август 2018. Београд, Србија

FIRST INTERNATIONAL CONFERENCE

ELMINA 2018

PROGRAM

&

BOOK OF ABSTRACTS

Rectorate of the University of Belgrade, Belgrade, Serbia
August 27-29, 2018
http://elmina.tmf.bg.ac.rs

Organized by:
Serbian Academy of Sciences and Arts and Faculty of Technology and Metallurgy, University of Belgrade

Endorsed by:
European Microscopy Society and Federation of European Materials Societies

FIRST INTERNATIONAL CONFERENCE
ELMINA 2018
Program and Book of Abstracts

Publisher:	Serbian Academy of Sciences and Arts Knez Mihailova 35, 11000 Belgrade, Serbia Phone: +381 11 2027200 https://www.sanu.ac.rs/en/
Editor:	Velimir R. Radmilović and Vuk V. Radmilović
Technical Editor:	Vuk V. Radmilović
Cover page:	Vuk V. Radmilović
Printed in:	Serbian Academy of Sciences and Arts Knez Mihailova 35, 11000 Belgrade, Serbia Phone: +381 11 2027128 stamparija@sanu.ac.rs
Circulation:	50 copies

ISBN 978-86-7025-785-6

At the beginning we wish you all welcome to Belgrade and ELMINA2018 International Conference organized by the Serbian Academy of Sciences and Arts and the Faculty of Technology and Metallurgy, University of Belgrade. We are delighted to have such a distinguished lineup of plenary speakers who have agreed to accept an invitation from the Serbian Academy of Sciences and Arts to come to the first in a series of electron microscopy conferences: Electron Microscopy of Nanostructures, ELMINA2018. We will consider making it an annual event in Belgrade, due to this year's overwhelming response of invited speakers and young researchers. The scope of ELMINA2018 will be focused on electron microscopy, which provides structural, chemical and electronic information at atomic scale, applied to nanoscience and nanotechnology (physics, chemistry, materials science, earth and life sciences), as well as advances in experimental and theoretical approaches, essential for interpretation of experimental data and research guidance. It will highlight recent progress in instrumentation, imaging and data analysis, large data set handling, as well as time and environment dependent processes. The scientific program contains the following topics:

- Instrumentation and New Methods
- Diffraction and Crystallography
- HRTEM and Electron Holography
- Analytical Microscopy (EDS and EELS)
- Nanoscience and Nanotechnology
- Life Sciences

To put this Conference in proper prospective, we would like to remind you that everything related to nanoscience and nanotechnology started 30 to 40 years ago as a long term objective, and even then it was obvious that transmission electron microscopy (TEM) must play an important role, as it was the only method capable of analyzing objects at the nanometer scale. The reason was very simple - at that time, an electron microscope was the only instrument capable of detecting the location of atoms, making it today possible to control synthesis of objects at the nanoscale with atomic precision. Electron microscopy is also one of the most important drivers of development and innovation in the fields of nanoscience and nanotechnology relevant for many areas of research such as biology, medicine, physics, chemistry, etc. We are very proud that a large number of contributions came from young researchers and students which was one of the most important objectives of ELMINA2018, and which indicates the importance of electron microscopy in various research fields. We are happy to present this book, comprising of the Conference program and abstracts, which will be presented at ELMINA2018 International Conference. We wish you all a wonderful and enjoyable stay in Belgrade.

TABLE OF CONTENTS

ORGANIZERS AND GENERAL INFORMATION VI

CONFERENCE PROGRAM IX

PLENARY ABSTRACTS 1

POSTER ABSTRACTS 73

AUTHOR INDEX 275

ACKNOWLEDGEMENTS 291

ORGANIZERS

SERBIAN ACADEMY OF SCIENCES AND ARTS
Knez Mihailova 35, 11000 Belgrade, Serbia
Phone: +381 11 2027200 / https://www.sanu.ac.rs/

FACULTY OF TECHNOLOGY AND METALLURGY, UNIVERSITY OF BELGRADE
Karnegijeva 4, 11000 Belgrade, Serbia
Phone: +381 11 3370425 / https://www.tmf.bg.ac.rs/

ELMINA 2018

CONFERENCE CHAIR

Velimir R. Radmilović

CONFERENCE MANAGER

Vuk V. Radmilović

INTERNATIONAL ADVISORY BOARD

Chair: Robert Sinclair (USA)

Members: Sara Bals (Belgium), Gianluigi Botton (Canada), Vladimir Bumbaširević (Serbia), Fu-Rong Chen (Taiwan), Vladica Cvetković (Serbia), Rafal Dunin-Borkowski (Germany), Rolf Erni (Switzerland), Hamish Fraser (USA), Ferdinand Hofer (Austria), Randi Holmestad (Norway), Đorđe Janaćković (Serbia), Wayne D. Kaplan (Israel), Vesna Lačković (Serbia), Joachim Mayer (Germany), Paul Midgley (UK), Eva Olsson (Sweden), Stephen Pennycook (Singapore), Dejan Popović (Serbia), Tamara Radetić (Serbia), Quentin Ramasse (UK), Frances Ross (USA), Etienne Snoeck (France), Erdmann Spiecker (Germany), Leposava Šiđanin (Serbia), Maria Varela del Arco (Spain), Johan Verbeeck (Belgium).

PROGRAM COMMITTEE

Chair: Velimir R. Radmilović (Serbia)

Members: Nataša Bibić (Serbia), Vladimir Bumbaširević (Serbia), Zoran Đurić (Serbia), Jasmina Grbović Novaković (Serbia), Aleksandra Korać (Serbia), Zoran Popović (Serbia).

ORGANIZING COMMITTEE

Chair: Petar Uskoković

Vice-chair: Zlatko Rakočević

Members: Anđelika Bjelajac, Vladan Ćosović, Ivana Cvijović-Alagić, Željko Kamberović, Smilja Marković, Nataša Nestorović, Irena Nikolić, Mirjana Novaković, Vladimir Pavlović, Vuk Radmilović, Dragan Rajnović, Milica Ševkušić, Đorđe Veljović.

TECHNICAL COMMITTEE

Chair: Đorđe Veljović

Members: Anđelika Bjelajac, Jovana Dimitrijević, Ivana Drvenica, Špiro Đurđević, Tamara Matić, Daniel Mijailović, Katarina Nešović, Vladimir Pavkov, Jelena Petrović, Anđela Radisavljević, Mia Radonjić, Željko Radovanović, Ivana Radović, Milena Stevanović.

Morphology of Nanotubular Oxide Layer Formation on Titanium and Titanium Alloy Using Electrochemical Anodization

Dragana R. Barjaktarević[1], Ivana D. Dimić[1], Ivana Lj. Cvijović-Alagić[2], Veljko R. Đokić[1] and Marko P. Rakin[1]

[1] *Faculty of Technology and Metallurgy, University of Belgrade, Karnegijeva 4 11120 Belgrade, Serbia*
[2] *Institute of Nuclear Sciences "Vinča", University of Belgrade, P.O. Box 522, 11001, Belgrade, Serbia*

Behavior of metal biomaterials is governed by surface properties, which is a crucial factor in interactions of the implant material with the surrounding tissue. The implant often needs some kind of modification to optimize and improve biological and mechanical properties of the surface. One of the most commonly used methods is the electrochemical anodization, a simple process used to form nanotubular oxide layer on the metal surface by oxidation [1]. In order to form nanotubular oxide layer on UFG commercially pure Ti and Ti-13Nb-13Zr alloy (coarse-grained, CG, and ultrafine-grained, UFG, obtained by high pressure torsion) the material surface was modified using chemical surface treatments, electrochemical anode oxidation. Anodization was done in 1M H_3PO_4 + NaF electrolyte, at room temperature. The anodization was performed during 30, 60, 90 and 120 minutes, for the desired potential of 25 V with a scan rate of 100 mVs^{-1}. The aim of the work was determining the influence of anodization time on morphology of nanotubular oxide layer. In order to analyze characteristics of the nanotubular oxide layer, Scanning Electron Microscope (SEM) MIRA3 TESCAN was used. The SEM operated at an accelerating voltage of 20 keV. As a result of the anodic oxidation highly ordered nanotubular layers were obtained.

The homogeneous morphology of nanotubular oxide layer was formed during 90 and 120 minutes, while inhomogeneous nanotubular oxide layer was formed during 30 and 60 minutes. There is a bimodal distribution size of nanotubes with diameters in the range of 40-100 nm for the CG TNZ alloy and in the range of 60-100 nm for the UFG TNZ alloy. Wall thickness was approximately 20 nm for the CG TNZ alloy and approximately 30 nm for the UFG TNZ alloy. Increasing anodization time increased the diameter and the wall thickness of the formed nanotubular oxide layer [2]. As can be seen in Figure 1, nanotubes formed on UFG TNZ surface have not regular and homogeneous morphology for shorter anodizing time, while increasing anodizing time caused the formation of homogeneous morphology. On the other hand, nanotubes formed on the CG TNZ surface did not have compact pore and homogeneous morphology for shorter anodizing time, while increasing anodizing time led to the formation of nanotubes with compact pore and homogeneous morphology. It is obvious that the nanotubes are open on the top. Also, Figure 1 shows that the nanotubular oxide layer on the UFG TNZ surface needs less time for formation. The bimodal feature observed in the diameter distribution of nanotubes could be ascribed to the difference in the growth rate and dissolution rate of each nanotube [3]. The non-uniform surface morphology of nanotubes may be conditioned by dual α'+β phase microstructure of the alloy in the case of phases etched primarily by the electrolyte. Figure 2 shows that nanotubular oxide layer was formed on UFG commercially pure Ti only during 60 minutes.

References :

[1] KH Kim *et al*, Dent. Mater. J. **28** (2009), 20-36.
[2] H Tsuchiya *et al*, Electroch. Acta **52** (2006), 94–101.
[3] XJ Feng *et al*, Acta Biomater. **4** (2008), 318–323.

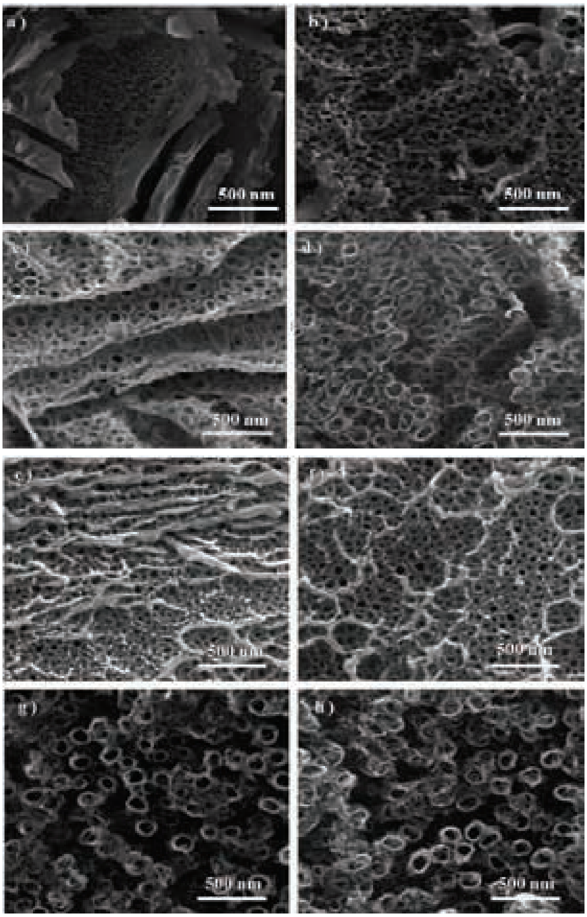

Figure 1. SEM micrographs of the nanotubular oxide layer formed on the CG Ti–13Nb–13Zr alloy (a), (b), (c), (d) and UFG Ti-13Nb- 13Zr alloy (e), (f), (g), (h) in $1H_3PO_4$ + NaF for 30, 60, 90 and 120 minutes, respectively for both materials.

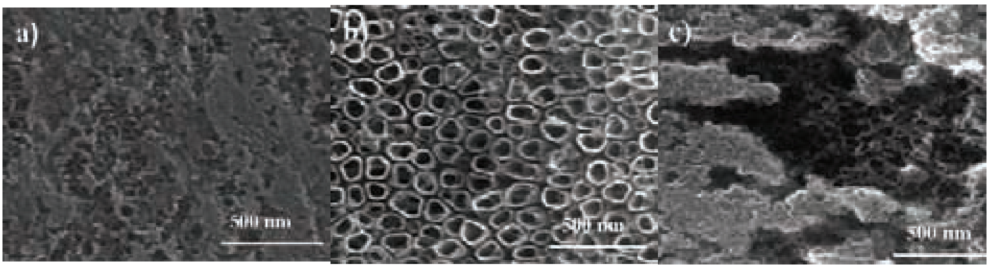

Figure 2. SEM micrographs of the nanotubular oxide layer formed on the UFG cpTi (a), (b), (c), (d) in $1H_3PO_4$ + NaF for 30, 60 and 90 minutes.

CIP - Каталогизација у публикацији
Народна библиотека Србије, Београд

66.017/.018(048)
544.2(048)
621.385.833.2(048)

INTERNATIONAL Conference on Electron Microscopy of Nanostructures ELMINA (1 ; 2018 ; Beograd)

Program ; & Book of Abstracts / First International Conference on Electron Microscopy of Nanostructures ELMINA 2018, August 27-29, 2018, Belgrade, Serbia = Прва међународна конференција о електронској микроскопији наноструктура ELMINA 2018, 27-29 август 2018. Београд, Србија ; [organized by Serbian Academy of Sciences and Arts and Faculty of Technology and Metallurgy, University of Belgrade ; editor Velimir R. Radmilović and Vuk V. Radmilović]. - Belgrade : SASA, 2018 (Belgrade : SASA). - XXIX, 289 str. : ilustr. ; 24 cm

Na nasl. str.: European Microscopy Society and Federation of European Materials Societies. - Tiraž 50. - Bibliografija uz svaki apstrakt. - Registar.

ISBN 978-86-7025-785-6
a) Наука о материјалима - Апстракти b) Нанотехнологија - Апстракти
c) Електронска микроскопија - Апстракти
COBISS.SR-ID 266767116