Innovation Center of Faculty of Mechanical Engineering

Faculty of Mechanical Engineering, University of Belgrade

Center for Business Trainings

CNN TECH

„International Conference of Experimental and Numerical Investigations and New Technologies“

Sponsored by:

MINISTRY OF EDUCATION OF THE REPUBLIC OF SERBIA

Programme

and

The Book of Abstracts

04 – 07 July 2023

Zlatibor, Serbia

„International Conference of Experimental and Numerical Investigations and New Technologies“

CNN TECH 2023

04 – 07 July 2023

Hotel Mona, Miladina Pecinara 26, Zlatibor, Serbia

http://cnntechno.com

Programme

and

The Book of Abstracts

Organised by:

Innovation Center of Faculty of Mechanical Engineering

Faculty of Mechanical Engineering, University of Belgrade

Center for Business Trainings

Sponsored by:

Ministry of Education of the Republic of Serbia

Title:	International Conference of Experimental and Numerical Investigations and New Technologies – **CNN TECH 2023** **PROGRAMME AND THE BOOK OF ABSTRACTS**
Publisher:	University of Belgrade - Faculty of Mechanical Engineering Kraljice Marije 16, 11120 Belgrade 35 tel: (+381 11) 3302-346, fax 3370364 e-mail: cnntechno@gmail.com web site: http://cnntechno.com, http://www.inovacionicentar.rs
Editors:	Dr Goran Mladenovic, Associate Professor Dr Martina Balac, Senior Scientific Researcher Dr Aleksandra Dragicevic, Scientific Researcher
Technical editor	Dr Goran Mladenovic, Associate Professor
Cover page:	Ivana Jevtic, Junior Researcher
Printed in:	Innovation Center of Faculty of Mechanical Engineering Kraljice Marije 16 11120 Belgrade 35 tel: (+381 11) 3302-346
Circulation:	150 copies. The end of printing: June 2023.

ISBN: 978-86-6060-155-3

“International Conference of Experimental and Numerical Investigations and New Technologies”

CNN TECH 2023

SCIENTIFIC COMMITTEE:

Nenad Mitrovic, Serbia (chairman)
Milos Milosevic, Serbia (co-chairman)
Aleksandar Sedmak, Serbia
Hloch Sergej, Slovakia
Drazan Kozak, Croatia
Nenad Gubeljak Slovenia
Monka Peter, Slovakia
Snezana Kirin, Serbia
Samardzic Ivan, Croatia
Martina Balac, Serbia
Mládková Ludmila, Czech Republic
Johanyák Zsolt Csaba, Hungary
Igor Svetel, Serbia
Aleksandra Mitrovic, Serbia
Valentin Birdeanu, Romania
Danilo Nikolic, Montenegro
Goran Mladenovic, Serbia
Bajic Darko, Montenegro
Tasko Maneski, Srbija
Luis Reis, Portugal
Zarko Miskovic, Serbia
Tozan Hakan, Turkey
Nikola Momcilovic, Serbia
Traussnigg Udo, Austria
Gordana Bakic, Serbia
Katarina Colic, Serbia
Peter Horňak, Slovakia
Róbert Huňady, Slovakia
Martin Hagara, Slovakia
Jovan Tanaskovic, Serbia
Marija Djurkovic, Serbia
Tsanka Dikova, Bulgaria
Ján Danko, Slovakia
Ognjen Pekovic, Serbia
Jelena Svorcan, Serbia
Suzana Filipovic, Serbia
Darko Kosanovic, Serbia
Nebojsa Manic, Serbia
Zorana Golubovic, Serbia
Vera Pavlovic, Serbia
Aleksandra Dragicevic, Serbia
Dragan Milkovic, Serbia
Bojan Cudic, Bosnia and Herzegovina
Vesna Miletic, Australia
Natasa Obradovic, Serbia
Branislav Sredanovic, Bosnia and Herzegovina

ORGANIZING COMMITTEE:

Milos Milosevic (chairman)
Nenad Mitrovic (co-chairman)
Aleksandar Sedmak
Martina Balac
Igor Svetel
Goran Mladenovic
Aleksandra Mitrovic
Aleksandra Lj. Dragicevic
Zarko Miskovic
Katarina Colic
Milan Travica
Aleksandra D. Dragicevic
Isaak Trajkovic
Toni Ivanov
Snezana Kirin
Igor Stankovic
Ivana Vasovic Maksimovic
Nina Obradovic
Ivana Jevtic
Jasmina Milenkovic
Mina Volic

enterprise europe network
Business Support on Your Doorstep

Invited lecture

FRACTAL ANALYSIS AND MICROSTRUCTURE DEVELOPMENT OF $BATIO_3$ AND PVDF BASED MULTIFUNCTIONAL MATERIALS

Adriana Peles Tadic[1*], George Vukovic[2], Aleksandar Kojovic[3], Dusica Stojanovic[3], Branislav Vlahovic[4], Natasa Milosavljevic[5], Nina Obradovic[1], Vladimir Pavlovic[5]

[1]Institute of Technical Sciences of SASA, Knez Mihailova 35/IV 11000 Belgrade, Serbia
[2]University of Wisconsin-Madison, USA
[3] University of Belgrade, Faculty of Technology and Metallurgy, Karnegijeva 4, 11120 Belgrade, Serbia
[4] North Carolina Central University, Durham, USA
[5] *University of Belgrade, Faculty of Agriculture, Department for Physics and Mathematics, Nemanjina 6, 11080 Belgrade, Serbia*
**Corresponding author e-mail: adriana.peles@itn.sanu.ac.rs*

Abstract

Barium titanate ($BaTiO_3$) and polyvinylidene fluoride (PVDF) based multifunctional materials are attracting a great scientific interest due to their excellent piezoelectric, pyroelectric and ferroelectric properties. These materials undergo controlled transformations through physical interactions and respond to environmental stimuli, such as temperature, pressure, electric and magnetic fields. Their properties strongly depend on synthesis procedures and obtained microstructures. This include intergranular contact surfaces of $BaTiO_3$ based materials, as well as, porous structure and cross-linking patterns of PVDF prepared by electrospinning. It has been found that these microstructures can have fractal structure and that the fractal analysis can be used as a powerful tool for describing structural and functional properties of these materials. Having this in mind, in this research we have used different fractal methods for the reconstructions of various $BaTiO_3$ and PVDF microstructure morphologies. Fractal analysis has been performed by using scanning electron microscope micrographs and computational modeling tools. Fractal dimension of irregular morphologies which exhibit fractal regularity were determined by using box-counting method. This method enables the analysis of self-similar microstructure morphologies by quantifying the rate at which an object's geometrical details develop at increasingly fine scales. Theory of Iterated Function Systems and Voronoi tessellation, have been used for modeling $BaTiO_3$ random microstructures and PVDF porous structures. A python algorithm was created to determine the distribution of pore areas in SEM micrographs. Algorithm's distribution of calculated pore surface areas was compared with measured pore surface areas and fractal reconstructions of different morphologies and their connection with functional properties were analyzed.

Keywords:

PVDF, $BaTiO_3$, Electrospinning, Fractals, Voronoi tessellation.

Acknowledgement

Funds for the realization of this work are provided by the Ministry of Education, Science and Technological Development of the Republic of Serbia, Agreement on realization and financing of scientific research work of the Institute of Technical Sciences of SASA in 2023 (Record number: 451-03-47/2023-01/200175), Faculty of Technology and Metallurgy, University of Belgrade (Record Number: 451-03-47/2023-01/200135), University of Belgrade, Faculty of Agriculture (Record number: 451-03-47/2023-01/200116) and the National Science Foundation grants HRD-1345219 and DMR-1523617, and the Department of Energy/National Nuclear Security Administration NA0003979 award.

CIP - Каталогизација у публикацији Народна библиотека Србије, Београд

621(048)(0.034.2)
62:519.6(048)(0.034.2)

INTERNATIONAL conference of experimental and numerical investigations and new technologies (2023 ; Zlatibor)
Programme [Elektronski izvor] ; and The Book of Abstracts / International Conference of Experimental and Numerical Investigations and New Technologies - CNN TECH 2023, 04 – 07 July 2023, Zlatibor, Serbia ; organized by Innovation Center of Faculty of Mechanical Engineering [and] University of Belgrade, Faculty of Mechanical Engineering, Center for Business Trainings ; [editors Goran Mladenovic, Martina Balac, Aleksandra Dragicevic]. - Belgrade : University, Faculty of Mechanical Engineering, 2022 (Belgrade : Innovation Center of Faculty of Mechanical Engineering). - 1 USB fleš memorija ; 1 x 2 x 5 cm

Sistemski zahtevi: Nisu navedeni. - Nasl. sa naslovne strane dokumenta. - Tiraž 150.

ISBN 978-86-6060-155-3

a) Машинство -- Апстракти b) Техника -- Нумерички методи -- Апстракти

COBISS.SR-ID 119652617