

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



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 perspective, 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

<b>ORGANIZERS AND GENERAL INFORMATION .....</b>	<b>VI</b>
<b>CONFERENCE PROGRAM .....</b>	<b>IX</b>
<b>PLENARY ABSTRACTS .....</b>	<b>1</b>
<b>POSTER ABSTRACTS .....</b>	<b>73</b>
<b>AUTHOR INDEX .....</b>	<b>275</b>
<b>ACKNOWLEDGEMENTS .....</b>	<b>291</b>

## 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 Janačković (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 Šidānin (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.

## The Effect of Alkaline Activator Molarity and Aging Time on the Structure of Inorganic Polymer

Marija Ivanović<sup>1</sup>, Ljiljana Kljajević<sup>1</sup>, Jelena Gulicovski<sup>1</sup>, Bratislav Todorović<sup>2</sup>,  
Adela Egelja<sup>1</sup>, Vladimir Pavlović<sup>3</sup> and Snežana Nenadović<sup>1</sup>

<sup>1</sup> *Institute of Nuclear Sciences Vinča, Department of Materials Science,  
University of Belgrade, Serbia*

<sup>2</sup> *Faculty of Technology of Leskovac, University of Niš, Serbia*

<sup>3</sup> *Institute of Technical Sciences of the Serbian Academy of Sciences and Arts,  
Knez Mihailova 35/IV, University of Belgrade, 11000 Belgrade, Serbia*

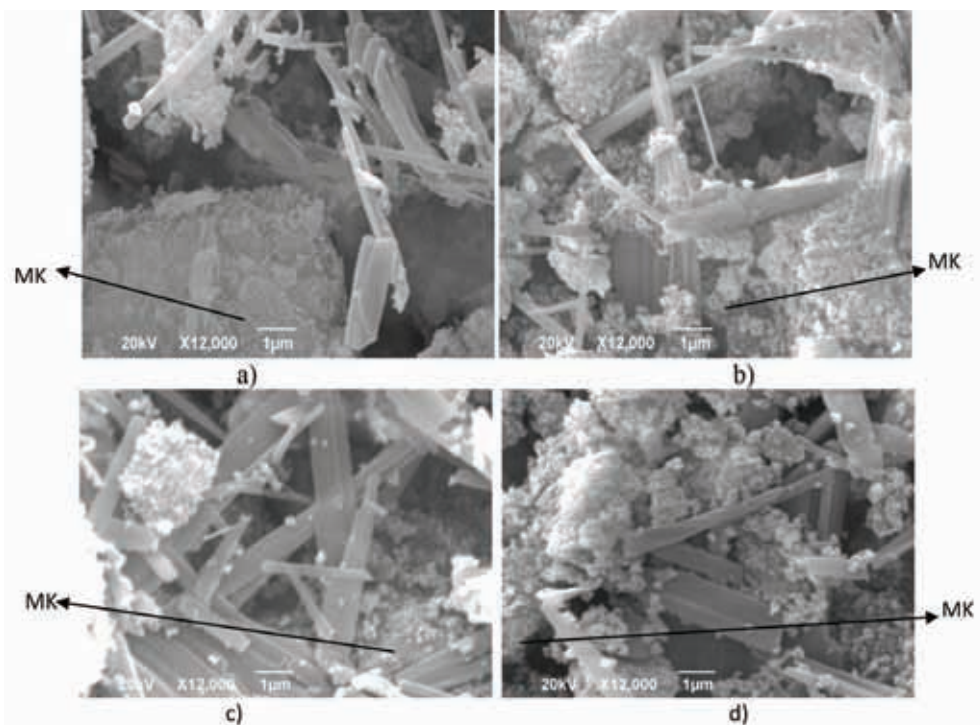
The goal of this research was to produce an environmental friendly, energy saving inorganic polymer using a metakaolin as a precursor. The clean technology which conserve the natural environment was employed for the production of these materials. The used kaolinite is clay obtained from Rudovci, Lazarevac, Serbia. Physicochemical properties of kaolin were investigated in previous work by Nenadović et al. [1]. Metakaolin (MK) was prepared by calcining kaolinite at 750 °C for 1 h. The influence of alkali activation, i.e. different concentration of NaOH as a component of alkali activator mixture on the process of polymerization of metakaolin is investigated. The alkaline solution was prepared from sodium silicate and 2M, 4M, 6M and 8 M NaOH (analytical grade) (volume ratio  $\text{Na}_2\text{SiO}_3/\text{NaOH} = 1.6$ ). The inorganic polymer (IP) samples were formed from metakaolin and the four different alkaline solution (solid/liquid ratio was about 1), which were mixed for 15 min and then left at room temperature for one day. Finally, the mixture was kept in a sample drying oven for 2 days at 60 °C. Process of aging time of inorganic polymer samples at 7<sup>th</sup>, 14<sup>th</sup>, 21<sup>st</sup> and 28<sup>th</sup> days is followed by some analytical methods (XRD, FTIR). X-ray diffraction (XRD) and Fourier transformation infrared spectroscopy (FTIR) were used for characterization of metakaolin and metakaolin based inorganic polymers. After 28<sup>th</sup> days when the aging time were finished, on the surface of the samples were used scanning electron

microscopy (SEM) with energy dispersive spectroscopy (EDS). XRD analysis almost of all inorganic polymer samples revealed their amorphous-like structure with the position of an amorphous halo in the range  $18^{\circ}$ - $32^{\circ}$ , which indicates short range ordering of the reference sample with crystalline admixture of  $\text{SiO}_2$  ( $\alpha$ -quartz, ICSD 89). The FTIR spectra of all samples shows a strong peak at  $\sim 1000 \text{ cm}^{-1}$  which is associated with Si–O–Si asymmetric stretching vibrations and is the finger print of the geopolymerization [2,3]. The FT-IR results show a shift of the Si-O or Si-O-X bands as the molarity of activator increasing during polymerization process, where X can be Si or Al. Both methods and XRD, as well as FTIR, show greater sensitivity to monitoring the effects of molarity, than the aging time within the same molarity to structural changes in inorganic polymer. SEM micrographs (Fig.1) showed a denser matrix, and a lower content of unreacted metakaolin particles due to increasing of molarity of NaOH. Structural reorganization of inorganic polymer samples occurs during the curing or aging in accordance with a polymerization mechanism.

#### References:

- [1] S Nenadović, *et al*, Environ. Earth. Sci. **73** (2015), 7669.
- [2] JW Phair, JSJ Van Deventer, Int. J. Miner. Process. **66** (2002), 121.
- [3] P Innocenzi, J. Non Cryst. Solids, **316** (2003), 309.





**Figure 1.** SEM micrographs of inorganic polymer: a) 2M NaOH b) 4M NaOH b) 6M NaOH d) 8M NaOH.

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

а) Наука о материјалима - Апстракти б) Нанотехнологија - Апстракти  
с) Електронска микроскопија - Апстракти

COBISS.SR-ID 266767116