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

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BOOK OF ABSTRACTS

Rectorate of the University of Belgrade, Belgrade, Serbia
August 27-29, 2018
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Organized by:
Serbian Academy of Sciences and Arts and Faculty of Technology and Metallurgy, University of Belgrade

Endorsed by:
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FIRST INTERNATIONAL CONFERENCE
ELMINA 2018
Program and Book of Abstracts

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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.

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Synthesis, Structure, Morphology and Properties of Biphasic $ZnO–ZnMn_2O_4$

Lidija Radovanović[1], Predrag Vulić[2], Željko Radovanović[1], Bojana Balanč[1], Bojana Simović[3], Ivana Zeković[4], Miroslav Dramićanin[4] and Jelena Rogan[5]

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Transition metal oxides are important materials that have found many applications, as capacitors, sensors or in energy storage [1]. Synthesis of these compounds has been realized by various methods, such as hydro(solvo)thermal synthesis, precipitation, microwave synthesis or sol-gel synthesis [2]. Recently, the thermolysis of coordination compounds as precursors has been considered as a new approach in obtaining functional nanosized materials. [3]. In this way, by selecting the proper precursor, it is possible to control the phase composition, morphology and particle size of a resulting material [3].

The biphasic powder composed of ZnO (zincite) and $ZnMn_2O_4$ (hetaerolite), (**I**) has been obtained by thermolysis of bimetallic complex $[MnZn_2(dipya)_3(tpht)_3(H_2O)_4]\cdot 2H_2O$ (dipya = 2,2'-dipyridylamine, tpht = dianion of 1,4-benzenedicarboxylic acid) at 450 °C during 1 h in air atmosphere. Scanning Electron Microscopy (SEM) was used to investigate the morphology of **I** (Figure 1). It can be observed that the morphology consists of deformed spherical grains of ZnO with an average diameter of 67 nm and elliptical grains of hetaerolite whose average diameter and length were 156 and 290 nm, respectively. The X-ray powder diffraction (XRPD) was applied to investigate the structure of **I**. In Figure 2 two-phase Rietveld refinement

pattern of **I** is presented (ZnO to $ZnMn_2O_4$ phase-ratio of 62:38 wt. %). The main crystallographic data and Rietveld refinement parameters for ZnO phase are: hexagonal, space group $P6_3mc$, a = 3.2574(1), c = 5.2175(2) Å, V = 47.945(3) Å^3; for $ZnMn_2O_4$ phase are: tetragonal, space group $I4_1/amd$, a = 5.7299(3), c = 9.3000(8) Å, V = 305.34(3) Å^3; R_{wp} = 4.80 %, R_p = 3.82 %, R_{exp} = 3.80 % and χ^2 = 1.5960. UV-Vis-NIR absorption spectrum was measured in order to investigate the direct band gap (E_g) of **I**. Due to the existence of two phases in **I**, two different E_g values of 2.4 and 3.3 eV for $ZnMn_2O_4$ and ZnO phase, respectively, were determined using Kubelka-Munk function. The mean size, polydispersity index (PDI) and zeta potential of spherical grains were measured using Zetasizer Nano Series, Nano ZS. The mean size was 418.6±53.1 nm while PDI value was found to be 0.354±0.099. Relatively high values of PDI and low apostate value of zeta potential (–6.55 mV) are indications of incipient instability of colloidal dispersion of **I**, probably due to the formation of agglomerates [4, 5]. Photoluminescence measurements were carried out at room temperature on Fluorolog-3 Model FL3-221 spectrofluorimeter system upon excitation at 350 nm, in order to study the optical properties of **I**. This analysis revealed one band centred at 422 nm in the blue region of the visible part of the spectrum, which can possibly be associated with defects in the crystal structure of the ZnO phase [6].

References:

[1] C Yuan *et al*, Angewandte Chemie International Edition **53** (2014), 1488.
[2] CNR Rao and B Raveau in "Transition Metal Oxides: Structure, Properties, and Synthesis of Ceramic Oxides" 2nd edition (WILEY-VCH, New York).
[3] MY Masoomi and A Morsali, Coordination Chemistry Reviews **256** (2012), 2921.
[4] R Greenwood and K Kendall, Journal of the European Ceramic Society **19** (1999), 479.
[5] M Staiger *et al*, Journal of Dispersion Science and Technology **23** (2002), 619.
[6] H Zeng *et al*, Advanced Functional Materials **20** (2010), 561.
[7] The authors acknowledge funding from the Ministry of Education, Science and Technological Development of the Republic of Serbia, Grant Number III45007.

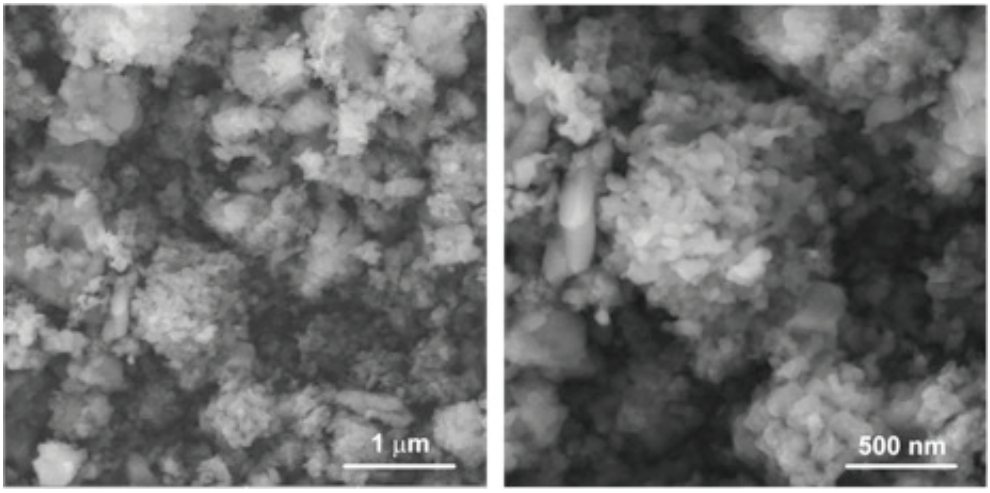

Figure 1. SEM images of **I**.

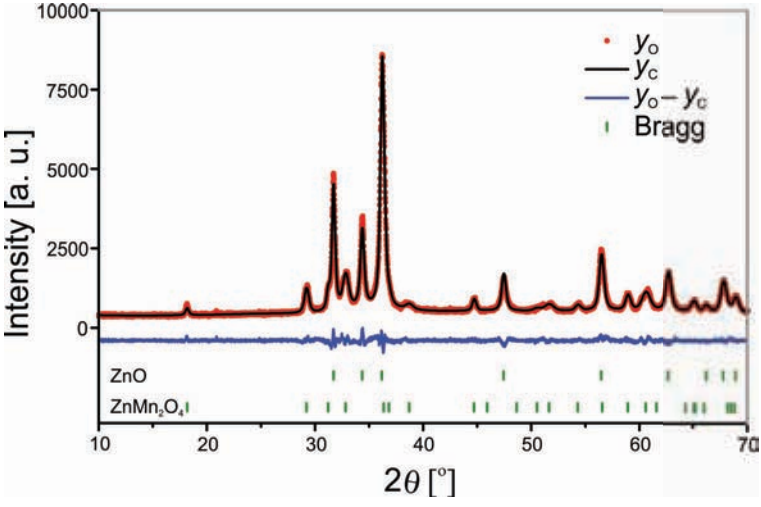

Figure 2. Rietveld refinement pattern of **I**.

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