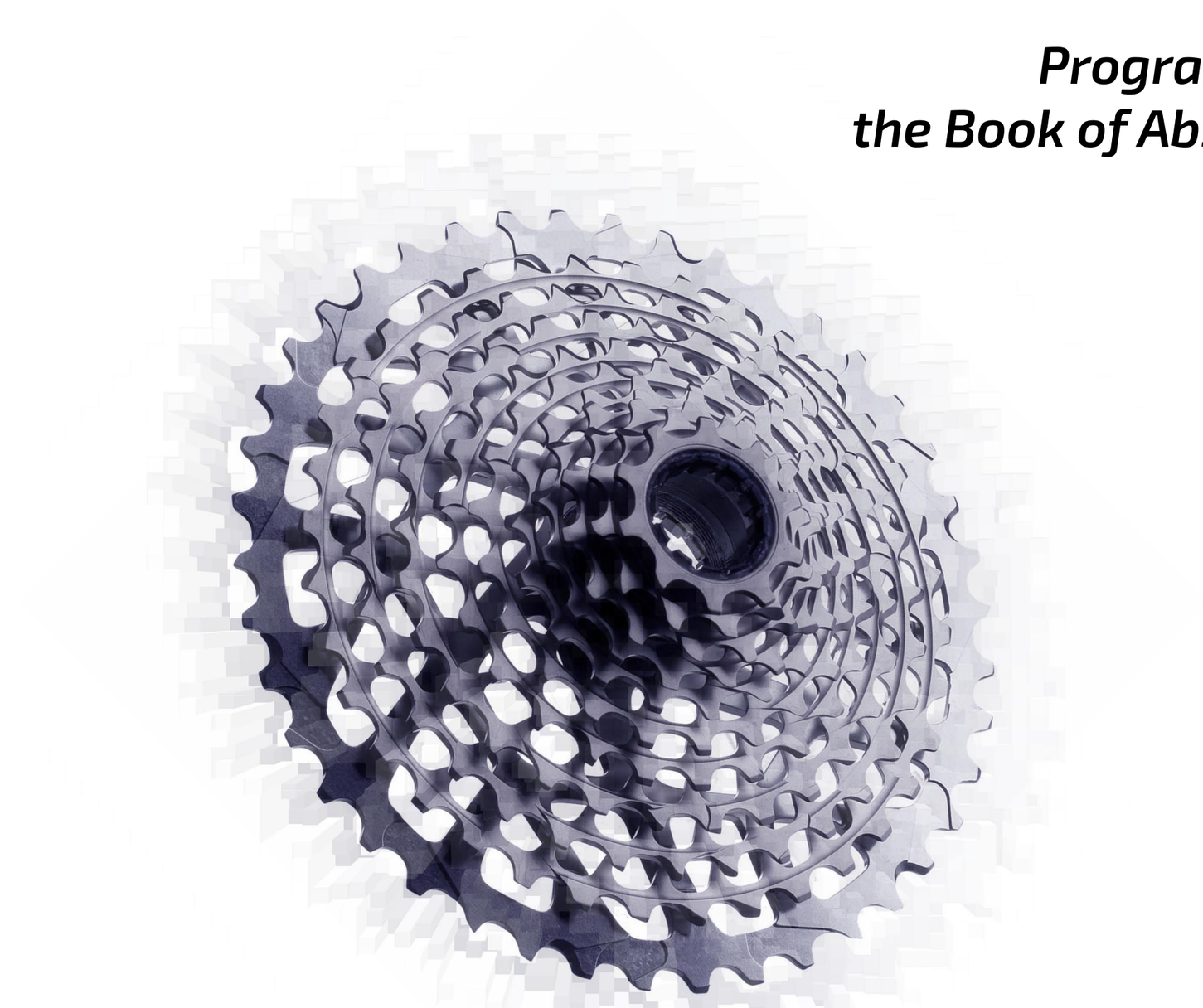
3rd International Symposium
on Materials for Energy Storage
and Conversion

September 10th-12th, 2018. Belgrade, Serbia

Programme & the Book of Abstracts



supported by

The royal family of Serbia

Republika Srbija
Ministarstvo rudarstva
i energetike

Republika Srbija
Ministarstvo prosvete,
nauke i tehnološkog razvoja

Gradska
Opština
GROCKA

INSTITUT FRANÇAIS
SERBIE

UNO-LUX NS

ANALYSIS
LABORATORY EQUIPMENT

DOGMA
BREWERY

AD HARBI

TRIVANOVIĆ
vinarija

MCLabor

Coca-Cola HBC
Srbija

SERBIA

VINČA INSTITUTE of NUCLEAR SCIENCES, UNIVERSITY of BELGRADE
HYDROGEN ECONOMY INITIATIVE SERBIA

PROGRAMME AND THE BOOK OF ABSTRACTS

3rd International Symposium on Materials for Energy Storage and Conversion - mESC-IS 2018

Edited by:

Nikola Novaković
Sandra Kurko
Sanja Milošević Govedarović
Jasmina Grbović Novaković

Book Title: 3rd International Symposium on Materials for Energy Storage and Conversion - mESC-IS 2018, Program and the Book of Abstracts

Publishers:
Vinča Institute of Nuclear Sciences, University of Belgrade, Belgrade
Hydrogen Economy Initiative Serbia, Belgrade

For Publishers:
Dr. Milica Marčeta Kaninski
Dr. Nikola Novaković

Editors:
Dr. Nikola Novaković
Dr. Sandra Kurko
Dr. Sanja Milošević Govedarović
Dr. Jasmina Grbović Novaković

Design:
Dr. Nikola Novaković

Technical editor:
Dr. Bojana Paskaš Mamula
Dr. Jelena Milićević
MSc. Tijana Pantić

ISBN 978-86-7306-140-5

Print: Knjigoveznica GRBOVIĆ, Belgrade : 100 copies

Committees & Boards

Conference Chair

Jasmina Grbović Novaković, Vinča Institute, Belgrade, Serbia

Conference Vice chair(s)

Bojana Paskaš Mamula, Vinča Institute, Belgrade, Serbia
Sandra Kurko, Vinča Institute, Belgrade, Serbia
Nikola Novaković, Vinča Institute, Belgrade, Serbia
Sanja Milošević Govedarović, Vinča Institute, Belgrade, Serbia

International Advisory Board

Dag Noreus, Stockholm University, Sweden
Daniel Fruchart, Neel Institute, Grenoble, France
Volodymyr Yartys, Institute for Energy Technology, Kjeller, Norway
Amelia Montone, ENEA, Casaccia, Italy
Patricia de Rango, Neel Institute, Grenoble, France
Nataliya Skryabina, Perm State University, Russia
Jose Ramon Ares Fernandez, Universidad Autónoma de Madrid, Spain
Tayfur Öztürk, Middle East Technical University, Ankara, Turkey
Kadri Aydınol Middle East Technical University, Ankara
Ruth Imnadze, Tblisi State University, Tbilisi
Saban Patat, Erciyes University, Kayseri
Slavko Mentus, Faculty of Physical Chemistry, University of Belgrade, Serbia
Šćepan Miljanić, Faculty of Physical Chemistry, University of Belgrade, Serbia
Jasmina Grbovic-Novakovic, Vinca Institute of Nuclear Sciences, Belgrade
Branimir Banov, IEES, Bulgarian Academy of Sciences, Sofia, Bulgaria
Fermin Cuevas, ICMPE/CNRS, Paris, France
Darius Milčius, LEI, Kaunas, Lithuania
Junxian Zhang, ICMPE/CNRS, Paris, France
Montse Casas-Cabanas, CIC Energigune, Álava, Spain

Program committee

Tayfur Öztürk, Middle East Technical University, Ankara, Turkey
Adam Revesz, Eotvos University, Budapest, Hungary
Dan Lupu, INCDTIM, Cluj-Napoca, Romania
Georgia Charalambopoulou, NCSR Demokritos, Greece
Miran Gaberšček, National Institute of Chemistry, Ljubljana, Slovenia
Nikola Biliškov, Ruđer Bošković Institute, Zagreb, Croatia
Maja Buljan, Ruđer Bošković Institute, Zagreb, Croatia
Branimir Banov, IEES, Bulgarian Academy of Sciences, Sofia, Bulgaria
Tony Spassov, Faculty of Chemistry and Pharmacy, Sofia University, Bulgaria
Perica Paunovic, FTM, Skopje, Macedonia
Siniša Ignjatović, UNIBL, Banja Luka, Bosnia and Herzegovina
Dragana Jugović, Inst Tech Sci SASA, Belgrade, Serbia
Ivana Stojković Simatović, Faculty of Physical Chemistry, University of Belgrade, Serbia
Igor Pašti, Faculty of Physical Chemistry, University of Belgrade, Serbia
Nenad Ivanović, Vinča Institute, Belgrade, Serbia
Ivana Radisavljević, Vinča Institute, Belgrade, Serbia
Milica Marčeta Kaninski, Vinča Institute, Belgrade, Serbia
Jasmina Grbović Novaković, Vinča Institute, Belgrade, Serbia
Nikola Novaković, Vinča Institute, Belgrade, Serbia
Sandra Kurko, Vinča Institute, Belgrade, Serbia

Organizing committee

Bojana Paskaš Mamula, Vinča Institute, Belgrade, Serbia
Jelena Milićević, Vinča Institute, Belgrade, Serbia
Tijana Pantić, Vinča Institute, Belgrade, Serbia
Sanja Milošević Govedarović, Vinča Institute, Belgrade, Serbia
Jana Radaković, Vinča Institute, Belgrade, Serbia
Katarina Batalović, Vinča Institute, Belgrade, Serbia
Igor Milanović, Ruđer Bošković Institute, Zagreb, Croatia,Vinča Institute, Belgrade, Serbia
Andjelka Djukić, Vinča Institute, Belgrade, Serbia
Bojana Kuzmanović, Vinča Institute, Belgrade, Serbia
Mirjana Medić Ilić, Vinča Institute, Belgrade, Serbia
Jelena Rmuš, Vinča Institute, Belgrade, Serbia
Željko Mravik, Vinča Institute, Belgrade, Serbia

Dear Colleagues,

Welcome to 3rd International Symposium on Materials for Energy Storage and Conversion - mESC-IS 2018 and the town of Belgrade!

The aim of the symphosium is to gather the researchers from Balkans, and all over Europe dealing with energy related materials to discuss on the important issues regarding energy storage, harvesting and conversion. First two very succesful symposia were organised in Turkey in 2015 and 2017 by professor Tayfur Öztürk, METU.

The symposium, as before, will provide a forum for discussion in recent progress made in three major activity areas, namely batteries, solid state hydrogen storage and fuel cells. The symposium have a fair balance of plenary sessions covering cross-cutting issues and the state of the art reviews and parallel sessions with contributed papers and poster presentation.

The papers from this conference will be published in International Journal of Hydrogen Energy Special Issue in order to disseminate the knowledge and to improve the visibility of symposiun

Dr. Jasmina Grbović Novaković
Dr. Nikola Novaković
Dr. Sandra Kurko

SESSION VII **MAIN HALL**

Chair: **Mykhaylo Lototskyy**

16:40 **Mesoporous TiO_2 photoanodes for application in dye-sensitized solar cells (DSSCs)**

Nikola Tasić[1], Zorica Marinković Stanojević[1], Zorica Branković[1], Uroš Lačnjevac[1], Milan Žunić[1], Vesna Ribić[1], Tatjana Novaković[2], Martina Gilić[3], Matejka Podlogar[4] and Goran Branković[1]
[1]Institute for Multidisciplinary Research, Department of Materials Science, University of Belgrade, Kneza Višeslava 1, 11030 Belgrade, Serbia
[2]IChTM-Department of Catalysis and Chemical Engineering, University of Belgrade, Njegoševa 12, 11000 Belgrade, Serbia
[3]Institute of Physics Belgrade, University of Belgrade, Pregrevica 118, 11080 Belgrade, Serbia
[4]Jožef Stefan Institute, Jamova cesta 39, SI-1000 Ljubljana, Slovenia

16:55 **Synthesis and characterization of Nb-doped lanthanum nickelate $La(Ni, Nb)O_3$**

Jelena Vukašinović[1], Milica Počuča-Nešić[1], Danijela Luković Golić[1], Zorica Branković[1],Aleksandra Dapčević[2], Goran Branković[1]
[1]Institute for Multidisciplinary Research, University of Belgrade, Kneza Višeslava 1, Belgrade, Serbia
[2]Faculty of Technology and Metallurgy, University of Belgrade, Karnegijeva 4, Belgrade, Serbia

17:10 **Improving energy efficiency in buildings with changing behaviour and integration of electrical energy storage**

Peter Virtič
University of Maribor, Faculty of Energy Technology, Hočevarjev trg 1, 8270 Krško

17:25 **Plasma induced grafting of polyacrylic acid on porous polypropylene membranes for their application as separators in alkaline water electrolysis**

Michal Stano, Ľubomír Staňo, Pavol Ďurina
Department of Experimental Physics, Faculty of Mathematics, Physics and Informatics, Comenius University, Bratislava, Slovakia

17:40 **Optimization of Graphene Synthesis by Electrochemical Exfoliation of Graphite**

Vahit Kurt, M. Kadri Aydınol
Department of Metallurgical and Materials Engineering,
Middle East Technical University, 06800, Ankara, Turkey

19:45 **CONFERENCE DINNER**

Restaurant REKA, Kej Oslobođenja 73, Beograd 11080
Bus transfer Hotel Majestic – Restaurant Reka **and back!**

Synthesis and characterization of Nb-doped lanthanum nickelate La(Ni, Nb)O_3

Jelena Vukašinović[1], Milica Počuča-Nešić[1], Danijela Luković Golić[1], Zorica Branković[1], Aleksandra Dapčević[2], Goran Branković[1]

[1]Institute for Multidisciplinary Research, University of Belgrade, Kneza Višeslava 1, Belgrade, Serbia

[2]Faculty of Technology and Metallurgy, University of Belgrade, Karnegijeva 4, Belgrade, Serbia

Perovskite type ceramic materials with general formula ABO_3 are very important class of materials due to their various chemical and physical properties. They have wide applications such as electrode material for solid state fuel cells (SOFC), capacitors, resistors, superconductors, catalysts, electrolytes, microwave devices, and magnetoresitant materials [1, 2]. Lanthanum nickelate ($LaNiO_3$, LNO) is a ternary oxide with rhombohedrally distorted perovskite lattice. In LNO trivalent nickel ions (Ni^{3+}) are in low spin configuration ($t_{2g}^6 e_g^1$) and the conduction band is formed by the hybridization of the e_g-orbitals of Ni^{3+} and the *p*-orbitals of oxygen. As a result, LNO shows metallic n-type conductivity in wide temperature range [3].

For this reason LNO has been proposed as a cathode material for intermediate-temperature SOFCs (IT-SOFCs) with operating temperature range of 650-800 °C. The possible dawbacks of LNO as a potential material for this application are poor density and thermal unstability at temperatures higher than 850 °C, when LNO starts gradually to decompose into the lower oxides $La_{n+1}Ni_nO_{3n+1}$ (n = 3, 2, 1) and NiO. Still, all of these La-Ni-O compounds exhibit high electronic conduction within the NiO_6 octahedra in their perovskite layers and excellent oxygen ionic conductivity through oxygen interstitials on the LaO rock-salt plane. Also, their coefficient of thermal expansion (CTE) matches those of materials commonly used as IT-SOFC electrolyte and anode [1].

A possible use of LNO as a cathode for SOFC requires the improvement of its thermal stability and enhancement of density of ceramic samples. The aim of this work was to fullfill these requirements by doping of lanthanum-nickelate into the B site. Using transition metal of higher valency than Ni^{3+} as a dopant, could enhance the electron concentration and carrier mobility, which results in improvement of electrical conductivity of ceramic material. Doping could also influence the sintering process and improve the density of the ceramic materials.

In this work we present dense ceramic materials of $LaNi_{1-x}Nb_xO_3$ (x = 0.005, 0.05) prepared by mechanochemically assisted solid state method. La_2O_3, NiO and Nb_2O_5, used as a precursor reagents, were mechanochemically activated in the planetary ball mill for 5 h. Obtained powders were calcined at 700 °C for 3h in air, and afterwards sintered at 900 °C and 1200 °C for 2 h and 10 h in different atmospheres (air and oxygen).

The influence of Nb doping on electrical properties and microstructure of $LaNi_{1-x}Nb_xO_3$ ceramic materials was investigated. All samples were analyzed by X-ray diffraction analysis (XRD), scanning electron microscopy (SEM) and energy dispersive X-ray spectroscopy (EDS). Electrical conductivity of ceramic $LaNi_{1-x}Nb_xO_3$ samples was measured in different mediums and complete characterization of electrical properties was performed.

The XRD analysis indicated the existence of secondary phases $La_{n+1}Ni_nO_{3n+1}$ and NiO along with the rhombohedral $LaNiO_3$. Samples sintered at 900 °C in oxygen atmosphere for 2 h had density of 64 % and 60 % for x = 0.005 and x = 0.05 (Fig. 1). The electrical conductivity was improved by doping with Nb, and obtained values were 2.7 S cm and 2.6 S cm for x = 0.005 and x = 0.05 at room temperature. The obtained results confirmed that doping by Nb along with sintering in oxygen atmosphere can improve electrical conductivity, density, and thermal stability.

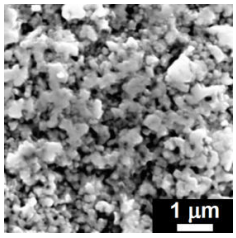


Figure 1. SEM micrograph of polished surface of $LaNi_{0.995}Nb_{0.05}O_3$ sample sintered at 900 °C in oxygen.

References

[1] R.K. Sharma, E. Djurado, J Mater Chem A, 5 (2017) 22277-22287.

[2].A. S. Bhalla, R. Guo, R. Roy, Mat Res Innovat, 4 (2000) 3-26.

[3] K. Sreedhar *et al.*, Phys Rev B, 46 (1992) 6382-6386.

Jelena Vukašinović

Jelena Vukašinović graduated in chemistry in 2013 at Faculty of Natural Sciences and Mathematics at the University of Kosovska Mitrovica and obtained her MSc in 2014 at Faculty of Chemistry at the University of Belgrade. Jelena began her PhD stadies in 2014 at Faculty of Chemistry and became a researcher trainee at Institute for Multidisciplinary Research.

Her research interests include synthesis and characterization of high-conductivity linear ceramic materials based on doped lanthanum nickelate ($LaNiO_3$, LNO) and zinc oxide (ZnO) obtained by chemical, mechanochemical and solvothermal synthesis.

e-mail, jelena.vukasinovic@imsi.bg.ac.rs, tel: +381 65 275 31 52