3rd International Meeting

on

Materials Science for Energy Related Applications

held on September 25-26, 2018

at the University of Belgrade, Faculty of Physical Chemistry,

Belgrade, Serbia

is a satellite event of

PHYSICAL CHEMISTRY 2018

14th International Conference on Fundamental and Applied Aspects of Physical Chemistry

organized by

KTH
ROYAL INSTITUTE OF TECHNOLOGY
Stockholm, Sweden

UNIVERSITY OF BELGRADE
FACULTY OF PHYSICAL CHEMISTRY
Belgrade, Serbia

in co-operation with

THE SOCIETY OF PHYSICAL CHEMISTS OF SERBIA

Funded by

Swedish Research Council

Scientific Committee

Prof. Natalia Skorodumova, *KTH - Royal Institute of Technology, Sweden,* chair

Prof. Richard G. Compton, *University of Oxford, England*

Prof. Börje Johanson, *Uppsala University, Sweden*

Prof. Andrei Ruban, *KTH - Royal Institute of Technology, Sweden*

Prof. Dmitri B. Migas, *Belarusian State University of Informatics and Radioelectronics, Minsk, Belarus*

Dr. Anton Kokalj, *Jozef Stefan Institute, Department of Physical and Organic Chemistry, Ljubljana, Slovenia*

Prof. Peter J. Walde, *ETH Zurich, Department of Materials, Switzerland*

Dr. Diogo M.F. Santos, *CeFEMA, Instituto Superior Technico, University of Lisbon, Portugal*

Prof. Slavko Mentus, *University of Belgrade – Faculty of Physical Chemistry, SASA, Serbia*

Prof. Gordana Ćirić-Marjanović, *University of Belgrade – Faculty of Physical Chemistry, Serbia*

Dr. Zorana Dohčević-Mitrović, *University of Belgrade, Institute of Physics, Serbia*

Dr. Biljana Šljukić Paunković, *University of Belgrade – Faculty of Physical Chemistry, Serbia*

Organizing Committee

Igor Pašti, *University of Belgrade – Faculty of Physical Chemistry, Serbia*, chair

Vladimir Panić, *University of Belgrade, Institute of Chemistry, Technology and Metallurgy, Serbia*

Nejc Hodnik, *National Institute of Chemistry, Ljubljana, Slovenia*

Nemanja Gavrilov, *University of Belgrade – Faculty of Physical Chemistry, Serbia*

Aleksandra Dapčević, *University of Belgrade – Faculty of Technology and Metallurgy, Serbia*

Ana Dobrota, *University of Belgrade – Faculty of Physical Chemistry, Serbia*

Sanjin Gutić, *University of Sarajevo, Faculty of Chemistry, Bosnia and Herzegovina*

Katarina Batalović, *University of Belgrade, Vinča Institute, Serbia*

Lidija Rafailović, *CEST, Wiener Neustadt, Austria*

Miloš Baljozović, *Empa - The Swiss Federal Laboratories for Materials Science and Technology, Switzerland*

Aleksandra Marković, *University of Oldenburg, Germany*

Edvin Fako, *ICIQ Institute of Chemical Research of Catalonia, Tarragona, Spain*

Aleksandar Jovanović, *University of Belgrade – Faculty of Physical Chemistry, Serbia*

PHYSICAL CHEMISTRY 2018

14th International Conference on Fundamental and Applied Aspects of Physical Chemistry

3rd International Meeting

MATERIALS SCIENCE FOR ENERGY RELATED APPLICATIONS

September 25-26, 2018, University of Belgrade – Faculty of Physical Chemistry, Belgrade, Serbia

BOOK OF ABSTRACTS

BELGRADE, SERBIA 2018

3rd International Meeting
on
Materials Science for Energy Related Applications

BOOK OF ABSTRACTS

Editors
Prof. Dr. Natalia V. Skorodumova
Dr. Igor A. Pašti
Dr. Biljana Šljukić Paunković

Technical Editors
Dr. Ana S. Dobrota
Aleksandar Z. Jovanović

Publisher
UNIVERSITY OF BELGRADE – FACULTY OF PHYSICAL CHEMISTRY
Belgrade, Serbia

For the Publisher
Prof. Dr. Gordana Ćirić-Marjanović

Printed by
Planeta Print – Beograd

Print run
80 copies

ISBN 978-86-82139-72-0

BELGRADE, SERBIA 2018

This Meeting is a part of the celebration of 210 years of the University of Belgrade.

УНИВЕРЗИТЕТ У БЕОГРАДУ

1808-2018

UNIVERSITY OF BELGRADE

Organisation of the Meeting was supported by the Ministry of Education, Science and Technological Development of the Republic of Serbia.

CIP - Каталогизација у публикацији
Библиотека Матице српске, Нови Сад

66.017:621.31(048.3)

INTERNATIONAL meeting on materials science for energy related applications (3 ; 2018 ; Belgrade)
Book of Abstracts / 3rd International Meeting on materials science for energy related applications, september 25-26, 2018, Belgrade [within] Physical chemistry 2018 - 14th International conference on fundamental and applied aspects of physical chemistry ; [editors Natalia V. Skorodumova, Igor A. Pašti, Biljana Šljukić Paunković]. - Belgrade : Faculty of physical chemistry, 2018 (Beograd : Planeta print). - 114 str. : graf. prikazi ; 18 cm

Tiraž 80. - Bibliografija uz svaki apstrakt.

ISBN 978-86-82139-72-0
1. International conference on fundamental and applied aspects of physical chemistry (14 ; 2018 ; Belgrade)
а) Материјали - Енергетика - Апстракти
COBISS.SR-ID 325233159

COMPARATIVE STUDY OF Ag/ZnO NANOPOWDERS OBTAINED BY SOLVOTHERMAL AND PRECIPITATION METHODS

B. Simović[1]*, A. Dapčević[2], Ž. Radovanović[3], A. Golubović[4], A. Matković[4], G. Branković[1]

[1]*Institute for Multidisciplinary Research, University of Belgrade, Belgrade, Serbia*
[2]*Department of General and Inorganic Chemistry, Faculty of Technology and Metallurgy, University of Belgrade, Belgrade, Serbia*
[3]*Innovation centre Faculty of Technology and Metallurgy, University of Belgrade, Belgrade, Serbia*
[4]*Center for Solid State Physics and New Materials, Institute of Physics, University of Belgrade, Belgrade, Serbia*
*bojanasimovic@imsi.bg.ac.rs

Beside wide range of applications, zinc oxide is recently recognized as a promising photocatalyst mainly used to degrade organic water pollutants. The great advantage of ZnO over TiO_2, which is the most common photocatalyst, is the absorption in wider solar spectrum, partly in the visible region [1]. Generally, the photocatalytic properties usually depend on the crystallinity and crystallite size, particle size, morphology and pore sizes, surface area, band gap energy, availability of active sites, number and nature of trapped sites, as well as on adsorption/desorption characteristics [2]. The modification of photocatalysts by noble metals can enhance their photocatalytic activity. This paper discuss the influence of synthetic method on photocatalytic activity of obtained powders.

Solvothermal and precipitation methods were chosen for the preparation of Ag/ZnO nanopowders. For the first one, the $Zn(CH_3COO)_2 \cdot 2H_2O$ with different $AgNO_3$ content (0, 0.75, 1.5 and 3 mol.%) was solvothermally treated at 120 °C for 18 h in the presence of poly(vinyl pyrrolidone), ethylene-glycol and NaOH. The obtained samples were rinsed out with distilled water, centrifuged and dried at 105 °C for 3h. In precipitation method, $Zn(CH_3COO)_2 \cdot 2H_2O$ was dissolved in ethylene-glycol in the presence of chitosan soluted in acetic acid, which was followed by addition of $AgNO_3$ in the same quantity as used for the solvothermal synthesis. The obtained suspension was heated up to 150 °C for 2 h and then calcined at 400 °C for 1 h (**Fig.1**).

The prepared samples were characterized by XRPD, FESEM, UV-vis techniques, while photocatalytic properties were tested on Reactive Orange 16 textile azo dye and compared to the commercial ZnO (the average particle size: 20 nm).

Based on XRPD, the predominant phase in all samples is ZnO with the weak reflections belonging to Ag for 0.75%Ag/ZnO, which become clearly visible for samples with 1.5 and 3% of Ag. The average crystallite size was calculated using Williamson-Hall method giving 20 ± 2 and 25 ± 2 nm for powders obtained by solvothermal and precipitation method, respectively. The calculated strains were insignificant probably due to low concentration of defects. On the other hand, this is not the case for commercial ZnO with strain of 0.25(3) %. This sample consists of nanoparticles with a slightly elongated spherical shape while all obtained ZnO nanopowders contain mutually similar nanoparticles with approximately spherical shape, which however create diverse forms of agglomerates. The average particle size was around 25 nm for solvothermally synthesized samples and approximately 30 nm for samples obtained by precipitation method.

Comparing to both unmodified ZnO and commercial one, all prepared Ag/ZnO samples showed a broad band at 450 nm (visible region) which causes the narrowing of band gap. The existence of this band is the confirmation that metallic Ag particles were formed, as indicated by XRPD, since they can absorb visible light and activate photocatalyst in visible spectrum.

The photocatalytic measurements showed that all synthesized nanopowders have higher adsorption power and photocatalytic activity than the commercial ZnO (Fig.1). This could be attributed to slightly elongated grains of commercial ZnO and the existence of significant strain. If compare the samples obtained by two different methods, Ag modified ZnO powders from solvothermal method are more efficient than the ones from precipitation method due to the smaller particles of silver.Larger Ag particles on ZnO could cause negative effects, such as light blocked, which result in the decrease of photocatalytic activity. The unmodified ZnO powders have the same efficiency regardless of the synthetic method. Comparing the photocatalytic activity of samples obtained by same method, the Ag distribution and its particle size seems to play the major role.

Summary, no matter which procedure was used, 1.5% Ag/ZnO powders have performed the highest effciency in degradation of RO16. It means that the photocatalytic activity does not depend only on Ag content but the metal distribution is important as well. In this work, it is shown that the optimized content of Ag amounts about 1.5 mol.% regardless of synthetic method and it could be recommended for further research in terms of economy.

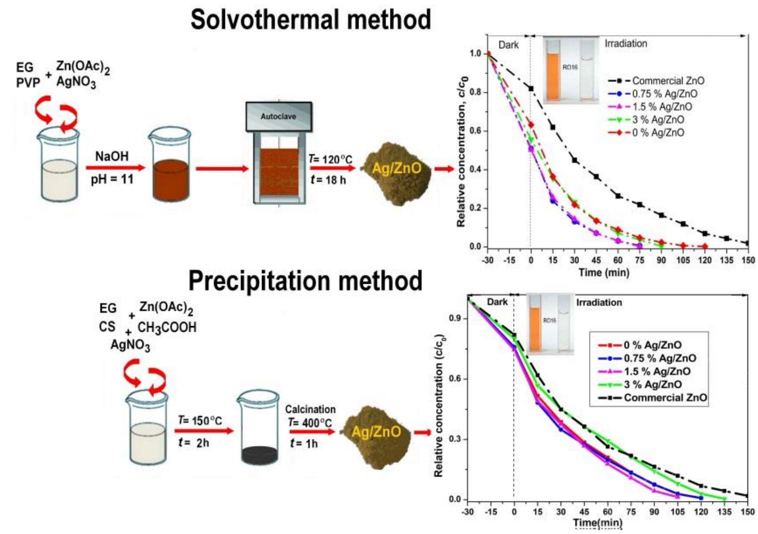

Figure 1. Experimental flowchart and photocatalytic efficiency of nanopowders.

References
[1] B. Simović *et al.*, J. Serb. Chem. Soc., 2014, 79, 1433.
[2] B. Simović *et al.*, Process. Appl. Ceram., 2017, 11, 27.