2020 EFCATS Summer School

Engineering materials for catalysis

15-19 September 2020
Portorož-Portorose
Slovenia

BOOK OF ABSTRACTS

SLOVENIAN CHEMICAL SOCIETY
Hajdrihova 19, P.O. Box 660
SI-1001 Ljubljana, Slovenia

2020 EFCATS Summer School

Book of Abstracts

Engineering materials for catalysis

15-19 September 2020
Portorož-Portorose
Slovenia

Editors: **Albin Pintar, Nataša Novak Tušar, Günther Rupprechter**
Illustrator: **Ronald Horvat**
Technical editor: **Taja Žgajnar, Infokart, d.o.o.**
Issued and published by:
Slovenian Chemical Society; Ljubljana, Slovenia, September 2020.

CIP - Katajožni zapis o publikaciji
Narodna in univerzitetna knjižnica, Ljubljana

544.478(082)(0.034.2)

EUROPEAN Federation of Catalysis Societies. Summer School (2020 ; Portorož)
Engineering materials for catalysis [Elektronski vir] : book of abstracts : 15-19 September 2020, Portorož - Portorose, Slovenia : [EFCATS Summer School 2020] / [editors Albin Pintar, Nataša Novak Tušar, Günther Rupprechter ; illustrator Ronald Horvat]. - Ljubljana : Slovenian Chemical Society, 2020

ISBN 978-961-93849-8-5
1. Gl. stv. nasl. 2. Pintar, Albin
COBISS.SI-ID 27152899

Novel doped perovskite catalysts – Enhancing catalytic activity by tailored exsolution of nanoparticles
L. Lindenthal, J. Popovic, R. Rameshan, T. Ruh, H. Summerer, A. Nenning, A. K. Opitz, S. Löffler, C. Rameshan 64

In-situ XRD analysis of potassium promoted cobalt molybdenum nitrides for catalytic application
A. Albrecht, P. Adamski, D. Moszyyński 65

Carbon spheres generated by hydrothermal carbonization as tailor-made reactive sorbent
M. Balda, A. Georgi, K. Mackenzie, F.-D. Kopinke 66

Synthesis and characterization of multifunctional graphene-based magnetic nanomaterials
T. S. Berberich, A. S. Silva, J. L. Diaz de Tuesta, S. D. Inglez, H. T. Gomes 67

Carbon nanofibers from plastic solid waste
J. P.M. Lopes, F. F. Roman, J. L. Díaz de Tuesta, G. G. Lenzi, J. L. Faria, A. M.T. Silva, H. T. Gomes 68

An NMR study of EDTA modified zeolite A – A search for enhanced catalytic sites
J. Volavšek, N. Zabukovec Logar, G. Mali 69

Mesoporous SSZ-13 synthesis via accelerated hydrolysis and condensation of tetraethyl orthosilicate
B. Ipek Torun 70

On-line FTIR-MS gas phase analysis of dimethylfuran conversion over zeolites for production of green aromatics
C. Sauer, M. Vestergren, A. Lorén, P.-A. Carlsson 71

Improving stability and activity of zeolite Y-based catalysts for the aqueous-phase hydrogenation of levulinic acid via La^{3+} cation exchange
H.-T. Vu, M. Goepel, R. Gläser 72

Direct synthesis of DME from syngas on hybrid catalysts based on Cu-ZnO(Al)/supported heteropolyacids: Effect of heteropolyacid loading on catalytic activity
E. Millán Ordóñez, N. Mota Toledo, R. Guil López, R. M. Navarro Yerga 73

Carbon nanofibers from plastic solid waste

Jéssica P. M. Lopes[a,b], Fernanda F. Roman[a,c], José L. Díaz de Tuesta[a], Giane G. Lenzi[b], Joaquim L. Faria[c], Adrián M. T. Silva[c], Helder T. Gomes[a]

[a] Centro de Investigação de Montanha (CIMO), Instituto Politécnico de Bragança, Campus de Santa Apolónia, 5300-253 Bragança, Portugal, [b] Universidade Tecnológica Federal do Paraná (UTFPR), Campus Ponta Grossa, Av. Monteiro Lobato, S/N km 04, Jardim Carvalho 84016-210 Ponta Grossa, Brasil, [c]Laboratory of Separation and Reaction Engineering – Laboratory of Catalysis and Materials (LSRE-LCM), Faculdade de Engenharia, Universidade do Porto, Rua Dr. Roberto Frias, 4200-465 Porto, Portugal

Production of plastics reached 360 million tonnes in 2018, the EU production corresponding to 62 million tonnes (i.e. 17%), from which only 9.2 million tonnes were collected for recycling. Low- and high-density polyethylene (PE) and polypropylene (PP), commonly used for packaging purposes, represent 40% of EU production [1]. In 2018, landfilling of plastic solid waste still represented 18.5% of the collected material [1], so there is still a great fraction of plastic waste being sent to landfill, representing a strong concern, as this plastic waste does not easily decompose. On the other hand, plastic polymers are mostly composed by carbon, as both PE and PP have a carbon content of 85.6% [2]. In this context, those plastics containing PE or PP represent a good source to produce carbon-based materials. In this work, low-density PE was used as precursor for the synthesis of carbon nanofibers (CNFs) by Chemical Vapour Deposition (CVD) (800 °C, 1 h, under N_2 flow), with the aim to evaluate the influence of different CVD catalysts based on Fe, Ni and Al, synthesized using coprecipitation or wet impregnation methods, on the valorisation of PE-containing plastic waste. Fig 1 displays the scanning electron micrographs (SEM) of the carbonaceous materials obtained using two different catalysts. As can be observed, filamentous carbons were obtained in both cases, attributed to the growth of CNFs. The CNFs were obtained with similar yields of carbonaceous material (37.6% with Ni+Fe@Al_2O_3-coprecipitation and 36.2% with Ni+Fe@Al_2O_3-wet impregnation). Catalyst Ni+Fe@Al_2O_3-coprecipitation (Fig 1(a)) led to the formation of entangled CNFs, with high density and diameters in the range 12 – 28 nm, with the catalysts metals visible at the tip of the fiber (brighter spots on the SEM image). On the other hand, the catalyst Ni+Fe@Al_2O_3-wet impregnation (Fig 1(b)) resulted in the growth of CNFs with higher apparent diameters, which indicates that the catalyst obtained via coprecipitation is more suitable for growing carbon nanostructures.

(a) (b)

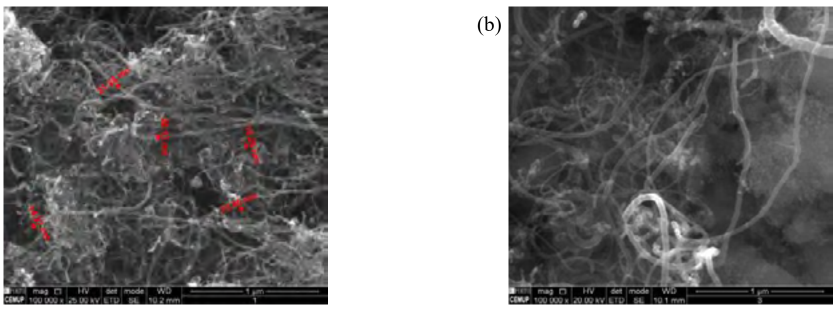

Fig 1. CNFs grown over (a) Ni+Fe@Al_2O_3-coprecipitation and (b) Ni+Fe@Al_2O_3-wet impregnation catalysts.

Key words: plastic waste; carbon nanofibers; chemical vapour deposition; valorisation; polyethylene.

Acknowledgments

This work was financially supported by project "PLASTIC_TO_FUEL&MAT – Upcycling Waste Plastics into Fuel and Carbon Nanomaterials" (PTDC/EQU-EQU/31439/2017), Base Funding - UIDB/50020/2020 of the Associate Laboratory LSRE-LCM - funded by national funds through FCT/MCTES (PIDDAC), and CIMO (UIDB/00690/2020) through FEDER under Program PT2020. Fernanda F. Roman acknowledges the national funding by FCT through the individual research grant SFRH/BD/143224/2019.

References

[1] Plastics – the Facts 2019, Plastic Europe Association of Plastics Manufactures, 2019.

[2] C. Zhuo and Y. Levendis (2014). Upcycling waste plastics into carbon nanomaterials: a review. Journal of Applied Polymer Science, vol. 39931, 1 – 14.

Corresponding author: Fernanda F. Roman (roman@ipb.pt)