proceedings

MDPI

Extended Abstract

Mesoporous SBA-15-Based Materials for Catalytic Hydroprocessing Reaction of Microalgal Biomass †

Alexandru Vlaicu [1,2], Gabriel Vasilievici [1,*], Adrian Radu [1], Simona Ghimis [1] and Sanda Velea [1]

[1] National Institute for Research & Development in Chemistry and Petrochemistry—ICECHIM Bucharest, 202 Spl. Independentei, 060021, Bucharest, Romania; alexvlaicu16@yahoo.co.uk (A.V.); serenity12ar@gmail.com (A.R.); simonaghimis@gmail.com (S.G.); sanda.velea@icechim.ro (S.V.).

[2] Faculty of Applied Chemistry and Materials Science, University Politehnica of Bucharest, 1-7 Polizu Street, 011061 Bucharest, Romania

* Correspondence: gabi.vasilievici@gmail.com

† Presented at the 16th International Symposium "Priorities of Chemistry for a Sustainable Development" PRIOCHEM, Bucharest, Romania, 28–30 October 2020.

Published: 11 November 2020

Keywords: mesoporous; hydrothermal; ceria; zirconia; microalgae; hydroprocessing

---

Mesoporous silica materials have attracted increasing attention to be considered as an important class of nanostructured support materials in heterogeneous catalysis. Their large surface area, well-defined porous architecture and ability to incorporate metal atoms within the mesopores lead them to be a promising support material for designing a variety of different catalysts. In particular, SBA-15 mesoporous silica has broad applicability in catalysis because of its comparatively thicker walls, leading to higher thermal and mechanical stability. From the current investigation are presented results for the hydroprocessing of microalgae *Chlorella* on a static reactor system, using mesoporous SBA-15-based catalysts. A comprehensive analysis was carried out on the bio-crude. GC-MS analysis was used to reveal the compositions of the bio-crude oil.

Ce-SBA-15, Zr-SBA-15 and Zr-Ce-SBA15 catalyst supports were prepared by the direct hydrothermal synthesis method using amphiphilic Pluronic P123 triblock copolymer [1]. The products were obtained and designed as Ce-SBA15-HM (molar ratio of Ce/Si = 0.1), Zr-SBA15-HM (molar ratio of Zr/Si = 0.1) and Zr-Ce-SBA15-HM (molar ratio of Zr/Si = 0.05 and Ce/Si = 0.05). For the second procedure, the post-synthesis method, cerium and zirconium were incorporated into an SBA-15 support by the wet co-impregnation method. These catalysts are named as Ce-SBA15-PM, Zr-SBA15-PM and Ce-Zr-SBA15PM. The prepared catalysts were characterized by TGA, BET, FTIR, IR and XRD analysis. Hydroprocessing reactions of microalgal biomass were carried out at 350 °C, and the pressure of H_2 was 40 bar. The heating rate of the reactor was 5 °C/min; once the operating temperature was reached, the temperature was held for 2.5 h.

From the XRD analysis, we obtained relevant data about the crystalline phases formed during synthesis. Wide-angle XRD of the catalysts suggested that Zr species are well dispersed on the mesoporous structure. The N_2 adsoption–desorption isotherms showed a typical type IV isotherm with a type H1 hysteresis cycle, indicating a hexagonal array typical of an SBA-15 mesoporous structure. The modification of SBA-15 by adding promoters such as Ce and Zr via the direct-synthesis method leaves almost unaltered its mesoporous structure. However, when Ce and Zr are incorporated into the sample by the post-synthesis method, the N_2 adsorbed volume isotherms decrease and the hysteresis loop is briefly altered.

In this study, ceria-, zirconia- and ceria–zirconia-based mesoporous catalysts were coupled to enhance the performance and physicochemical properties of the catalysts. The characterization results for the catalysts revealed the presence of mesopores in the catalysts. A microalga suspension

was successfully processed in a static catalytic hydroprocessing reactor, at a temperature of 350 °C. Our results show that alga feedstock can be converted into high-quality bio-products (bio-crude and bio-oil).

Acknowledgments: This work was supported by PN III Program, PN-III-P1-1.2-PCCDI-2017; Program 1—Development of national CD system; Subprogram 1.2—Institutional performance, complex projects developed in CDI consortia, Contract 32PCCDI/2018.

Reference

1. Rivoira, L.P.; Valles, V.A.; Martínez, M.L.; Sa-ngasaeng, Y.; Jongpatiwut, S.; Beltramone, A.R. Catalytic oxidation of sulfur compounds over Ce-SBA-15 and Ce-Zr-SBA-15. *Catal. Today* **2019**, in press, doi:10.1016/j.cattod.2019.08.005.