MCM-22 lamellar zeolite hollow microspheres supported with niobium An active catalyst to biomass conversion

Anderson Joel Schwanke (PG), Sibele Berenice Castellã Pergher (PQ)

*Universidade Federal do Rio Grande do Norte – LABPEMOL – Laboratorio de Peneiras Moleculares. Av. Senador Salgado Filho, 3000. Campus Universitário Lagoa Nova,59078-970 , Natal- RN. *anderson-js@live.com*

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Abstract

A hard templating methodology it used to generate MCM-22 lamellar zeolite with hollow microspheres structure. The material was supported with niobium niobium and used to conversion fructose reaction to 5-HMF reaching 85% of fructose conversion and yield of 65% to 5-HMF within 1h of reaction.

Introduction

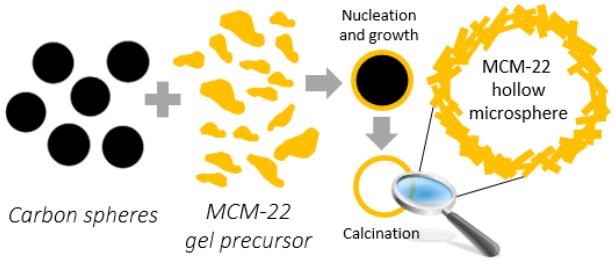

Figure 1. Scheme formation of MCM-22 hollow microspheres.

Lamellar zeolite type MCM-22 have been receiving considerable attention as supports and catalysts. Their potential use is due to its high specific area and the small crystal size and post-synthesis modification versatility. Furthermore, the small size of zeolite crystals could difficult its recover in reaction media, ex. by filtration or centrifugation. Thus, an interesting approach to generate hierarchical porosity and increased active surface of the solid per unit mass without loss its structure and specific area[1]. Thus, this work aims to evaluate the use carbon black pearls (BP2000) as hard template to formation of MCM-22 hollow microspheres (HM). The sample impregnated with niobium (5%) was used to reaction of fructose conversion to 5-HMF, an interesting biofuel platform derived from biomass[3].

Results and discussion

By XRD (Fig. 2) it was observed that insertion carbon spheres maintain the structure and crystallinity when compared to precursor without BP. After calcination is formed the 3D-MCM-22-HM. The formation of spheres was observed (Fig. 3) by FESEM and by TEM proves its hollow aspect by contrast difference due to white regions inside the sphere. By images *c* and *d* were observed the homogeneously of spheres and niobium (green dots) well dispersed without formation of bulk or clusters, respectively.

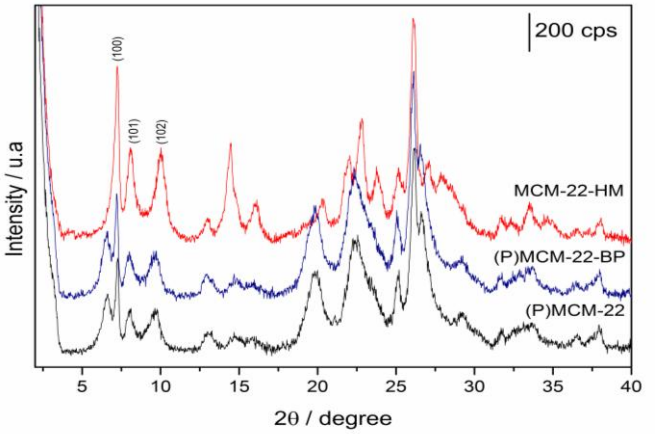

Figure 2. XRD of MCM-22 precursors (with and without carbon BP) and calcined MCM-22 hollow microsphere.

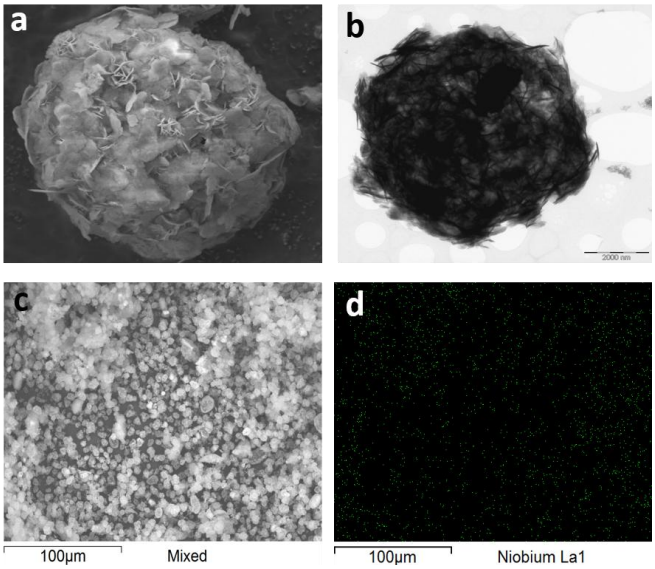

Figure 3. Microscopic images of MCM-22-HM.

MCM-22-HM-Nb5.6% was active with 85% of fructose conversion and 65% yield of 5-HMF within 1h (batch reaction, DMSO as solvent at 120°C)

Conclusions

The use of black pearls carbon as inexpensive hard template is very attractive to obtain MCM-22 hollow microspheres. The catalyst was active with high conversion fructose and yields of 5-HMF in shorter times of reaction (1h).

[1] Naibo Chu, Jinqu Wang, Yan Zhang, Jianhua Yang, Jinming Lu, and Dehong Yin. *Chem. Mater* 2010 *22* (9), 2757-2763

[2] Claus J. H. Jacobsen,* Claus Madsen, Jindrich Houzvicka, Iver Schmidt, Anna Carlsson, J. Am. Chem. Soc. 2000, 122, 7116-7117

[3] Joseph J. Bozell Gene R. Petersen *Green Chem.*, 2010,12, 539-554