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# Rapid synthesis and characterization of CeMCM-41

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**Abstract** – Nanostructured cerium incorporated MCM-41 molecular sieves were synthesized via room temperature method. Characterization of these materials by X-ray diffraction and nitrogen adsorption indicates that the resulting materials possess an MCM-41-like mesoporous structure. The TG curve presented two consecutive losses: the first in regard to the removal of superficial water or even the pores of CeMCM-41; the second is characteristic of the oxidation of organic composites. With the introduction of Ce in the structure of the mesopores, changes in the morphology were observed, going from hexagonal to conglomerates. In addition, the sum of those properties indicates that those matters can be used in catalytic applications.

The MCM-41 mesoporous materials exhibit much higher surface area (600-1300 $m^2/g$), and larger pore size (2-30 nm), exhibiting widely potential applications in industrial catalytic reactions [1]. But unfortunately, these mesoporous materials have relatively low catalytic activity; can be attributed to the low acidity or low oxidation ability of catalytically active species, which is strongly related to the amorphous nature of the pore walls. Therefore, increasing acidity and oxidation ability are great tasks for rational syntheses of ordered mesoporous materials. To increase its activity it is suggested to incorporate Al or transition metals in the structure of MCM-41.

Accordingly, we now report on the detailed synthesis at room temperature and characterization of $Ce^{3+}$ containing MCM-41-type mesoporous molecular sieves. The following Si/Ce molar ratio was used in the samples: 200; 100; 50, 25 and 10. The benefits of using room temperature route are short reaction times, cost and power savings and no need to use expensive auto claves [2]. For characterization of the material, techniques of X -ray diffraction (XRD), adsorption of nitrogen (BET/BJH), thermal analysis (TG-TDA), Infrared spectroscopy (IR) and scanning electron microscopy (SEM).

The XRD patterns (Fig. 1) show a strong diffraction at 2θ smaller than 2.5 along with the presence of small peaks thus confirming the formation of the mesoporous materials. It can be seen that one very intense peak (1 0 0) appeared in all the samples. All the samples display isotherms of type IV, which is characteristic of well ordered mesopores materials. The superficial areas of MCM-41 was of 1417 $m^2g^{-1}$, however, with the increase of the quantity of Ce, the superficial area reduces, example of nitrogen adsorption isotherms (Fig. 2). The TG curve presented two consecutive losses: the first in regard to the removal of superficial water or even the pores of CeMCM-41; the second is characteristic of the oxidation of organic composites. The assignment of the main infrared bands due to the *T*–O–*T* vibrations (*T* = Si, Ce) in the internal tetrahedra (IT) and external linkages (EL). With the introduction of Ce in the structure of the mesopores, changes in the morphology were observed, going from hexagonal to conglomerates. In addition, the sum of those properties indicates that those matters can be used in catalytic applications.

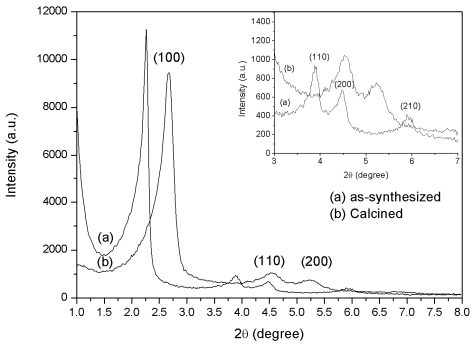


**Figure 1:** X-ray diffraction patterns of 200CeMCM-41 (Si/Ce = 200) sample.

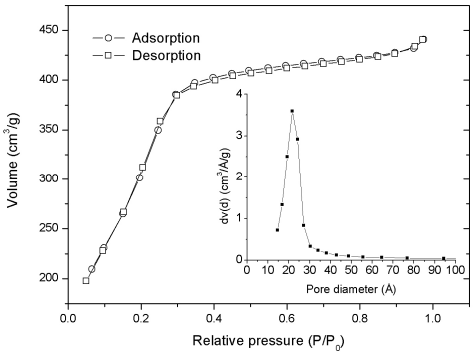


**Figure 2:** Nitrogen adsorption isotherms of 200CeMCM-41 (Si/Ce = 200) sample.

## References

[1] Feng-Shou Xiao. Topics in Catalysis, 35, 1–2, June 2005.

[2] T.R. Gaydhankar, V. Samuel, R.K. Jha, R. Kumar and P.N. Joshi. Materials Research Bulletin xxx (2007) xxx–xxx.