CHARACTERIZATION OF NANOPOROUS PILLARED CLAYS

A. Gil, A.G. Dachary, S. A. Korili

Universidad Pública de Navarra, Departamento de Química Aplicada,
Edificio Los Acebos, Campus de Arrosadía, 31006 Pamplona
sofia.korili@unavarra.es

Nanoporous materials have the important properties of very high specific surface area and large pore volume that, combined with other properties such as good stability and appropriate surface chemistry, make them a new generation of functional materials. Nanoporous solids find continuously expanding applications in the fields of environmental separations, membranes, sensors, energy storage, catalysis and photocatalysis, and biotechnology [1].

The pores of the nanoporous materials, having an opening of a few nanometers, create an internal network of interconnected microscopic channels that has as a result an extremely high surface to volume ratio. It is due to this extended pore system that the microporous solids have their unique gas adsorption and storage capacity. The internal area of these solids can also serve as a medium for the attachment and stabilization of active components thus avoiding fine powder forms that usually cause operational problems.

The determination of surface area, pore volume and pore size distribution of the solids is achieved by gas adsorption experiments. The experimental part is often followed by mathematical modeling and computer simulation in order to gain sight into the sorption phenomena and the behavior of complex real systems.

Within this context, we have developed a series of nanoporous materials with catalytic potential, starting from a commercially available natural clay of relatively low surface area. The first step of the sample preparation is the incorporation of aluminum polycations, which, after adequate thermal treatment, give thermally stable aluminum oxides that act as pillars between the clay layers. The resulting pillared materials have an increased surface area and a porous structure of molecular dimensions. Then, manganese is introduced to the pillared solids, giving them interesting properties for environmental applications such as the purification of contaminated gas streams by catalytic combustion. The surface area and pore size of the samples is determined by the physical adsorption of two model adsorbents, nitrogen at 77 K and carbon dioxide at 273 K. The micropore distributions are studied in detail taking into account several theories and adsorptive models [2].

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References:

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