Synthesis of iron-modified porous clay heterostructures (Fe-PCHs) from a raw Uruguayan montmorillonite

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Porous clay heterostructures (PCH) are nanoporous materials that exhibit a high specific surface area, a combined microporous and mesoporous structure, and high thermal and mechanical stability. These materials are of great interest due to their potential application as adsorbents, catalyst supports and porous matrices for the encapsulation and controlled release of drugs [1,2]. PCHs are obtain by the modification of a cationic layered silicate with a surfactant and a silica precursor, followed by heat treatment to remove the surfactant.
The aim of this work was to prepare iron-modified PCHs (Fe-PCHs) from a Uruguayan raw montmorillonite, with potential application as catalysts in Fenton process. Fe-PCHs were prepared by exchange the raw clay with a solution of hexadecyltrimethylammonium and hexadecylamine as co-surfactant, followed by the incorporation of tetraethoxysilane. Finally, the solid was exchanged with a ferric nitrate solution using different concentrations: 1 and 4 mol/L and thermally treated at 650 ºC in air to obtain Fe-PCH-1 and Fe-PCH-4, respectively. The characterization of the clay and the catalysts involved: XRD, XRF, TGA and nitrogen adsorption isotherm techniques.
The Fe content for Fe-PCH-1 and Fe-PCH-4 is 1.55 and 1.75%, respectively, thus confirming the effective incorporation of iron. Due to the generation of the nanoporous structure, the Fe-PCHs have significantly higher surface area (386 and 378 m^2/g) and pore volume (0.294 and 0.306 cm^3/g) than the clay (28 m^2/g and 0.043 cm^3/g). These properties suggest that Fe-PCHs are suitable candidates for catalytic processes that involve iron as active species.
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