Synthesis and characteristics of CMK-3 modified with magnetite nanoparticles for application in hydrogen storage

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Abstract In this work, we report the synthesis and characterization of iron oxide nanoparticles supported in nanostructured carbon (CMK-3). This material is promising in the application of hydrogen adsorption for energy storage. The material with iron oxide nanoparticles (Fe-CMK-3) was successfully synthesized and characterized by X-ray diffraction, textural properties analysis, transmission and scanning electron microscopy, X-ray photoelectron spectroscopy, and magnetization studies. A large amount of the iron incorporated as iron oxide nanoparticles was in the magnetite phase. The incorporation of magnetite on the CMK-3 carbon surface significantly improved the storage capacity of hydrogen (4.45 wt% at 77 K and 10 bar) compared with the CMK-3 framework alone (2.20 wt% at 77 K and 10 bar). The synthesized material is promising for hydrogen adsorption by weak bond forces (physisorption). A hydrogen adsorption mechanism was proposed in which the nanoparticles of magnetite have an important role.

Keywords Magnetite · CMK-3 · Hydrogen · Storage · Adsorption · Nanocomposites

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