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Synthesis and Characterization of the Anatase Loaded Mesoporous Photocatalyst

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Extended Abstract

Design of nano- and/or cluster-sized photocatalysts within mesoporous silica-based materials have been widely studied for heterogeneous photocatalytic processes in the past several decades (Qian et al., 2014). The adsorption of organic substrates as well as crystallinity of the TiO_2 photocatalyst can be largely affected by the nature of the used support (Kannaiyan et al., 2010). Mesoporous materials such as clays, zeolites and mesoporous silica, are considered an ideal class of catalyst supports because their large surface areas and uniform pore size distribution permit easy diffusion of large organic molecules toward internal active sites (Wang Z., 2007). Recently, much attention has been drawn to the preparation of porous silica-titania materials that have a higher percentage of the titania in a uniformly dispersed state, since such materials have some advantages compared to pure titanium oxide (Ruzimuradov et al., 2011). Photocatalytic components such as anatase can be embedded in the mesoporous silica using the following synthesis methods: wet impregnation, inner-pore hydrolysis/nonhydrolysis, co-hydrolysis and co-condensation, sol-gel processes and sol-gel/hydrothermal methods (Masolo et al., 2014).

This paper presents the synthesis and characterization of the mesoporous material based on MCM-41/TiO_2, used as a potential material with catalytic activity for degradation of organic pollutants. The synthesis of this type of material with catalytic properties occurs in two stages. In the first stage, the mesoporous silica with MCM-41 hexagonal pores is synthesized, using the following components and amounts. 0.5g of CTAB with the role of pores forming agent or template are stirred with 96ml H_2O until the solution becomes clear, followed by adding 34ml ethyl alcohol and ammonia solution with a concentration of 25%. After homogenization, TEOS (tetraethylorthosilicate) is added slowly and stirred for 3h, subsequently followed by filtration and drying. The surfactant is removed by calcination at 550^0C for 9 h, according to the DTA-TG analysis. The formation of the MCM-41 with hexagonal pores was confirmed by XRD. The incorporation of the titanium precursor in the pores of mesoporous silica was done using an adequate amount of titanium (IV) isopropoxide reported to the amount of MCM-41, the final content of anatase being 1 and 10% respectively. The titanium precursor was absorbed into the mesopores under vacuum followed by hydrolysis of the precursors. In order to prevent hydrolysis and facilitate adsorption of titanium (IV) isopropoxide in the pores of mesoporous silica, the former is added as mixture in ethyl alcohol, followed by solvent evaporation in the oven at the temperature of 80^0C.

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