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Abstract

Pt Supported on CeTi-Modified Hexagonal Mesoporous Silica as Photocatalysts for Degradation of Phenols in Water †

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Abstract: Aromatic compounds such as phenol and its derivatives are among the most common organic pollutants released by various industries. Recently, there has been a growing interest in the oxidative photodegradation of organic pollutants from water by coupling two semiconductor particles with different band-gaps and to modify their surface by doping with metal ions. The objective of this work is to evaluate the effect of Pt and CeO_2 on photocatalytic properties of Ti-modified SBA-15 mesoporous support. The influence of the synthesis parameters on morphology, ceria-titania interaction, Pt oxidation state as well as photocatalytic activity in degradation of phenol and catechol (2×10^{-4} M) aqueous solution was evaluated. SBA-modified support, with 5% TiO_2, was prepared by hydrothermal method in the presence of block copolymer P123 and butanol. The support was impregnated with ceria (1%) and Pt (0.5 and 1%) precursors. The obtained materials were characterized by X-ray diffraction, nitrogen adsorption, SEM and TEM microscopy, XPS, PL and DRS UV-Vis spectroscopy. $HO^{\bullet}$ radicals from the surface were detected by fluorescence technique. The results evidenced a mesoporous ordered structure, high dispersion of titania, ceria and platinum species, interaction of CeO_x and Pt^0/Pt^{2+} nanoparticles with well dispersed TiO_2 on silica supports, oxygen vacancies and their effect on photocatalytic properties. XPS showed the percentage of Ce^{3+}, stabilized by the presence of Pt^0, which significantly influenced the presence of the oxygen vacancies. The lower Pt loading and its high dispersion enhanced the absorption of visible light further by junction between Pt and TiO_2. As the photo-excited electrons in the conduction band of TiO_2 can migrate to the Pt increasing the sample activity. Under UV light the best results were obtained for samples with Ti and PtTi. The obtained results evidenced the possibility to activate TiO_2 in the UV light and to control photocatalytic activity by synthesis method.

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