Influence of Carbon Nature on the Photocatalytic Properties of Carbon/TiO_2 Hybrids for Elimination of Volatile Organic Compounds in Gas Phase

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Adsorbent-Photocatalyst Hybrids (APHs) based on graphitized carbons and TiO_2, for the degradation of volatile organic compounds in gas phase were studied. Commercial Starbons with different hydrophobicity and micro-mesoporosity, activated and graphitized mesoporous carbons were selected as adsorbents to prepare the carbon/TiO_2 composites. The influence of carbon nature and the way in which titania nanoparticles are incorporated on the carbonaceous materials for the photoactivity of the composites has been analyzed. The physicochemical properties of the raw materials and carbon/TiO_2 hybrids were analyzed by N_2 adsorption-desorption, XRD, UV-Vis spectroscopy, contact angle, SEM and HRTEM-EELS. The adsorption capacity of the photocatalysts towards the volatile organic compound (formaldehyde and trichloroethylene) at dynamic conditions was also evaluated. The results obtained in this work show the importance of the preparation route for the distribution of the TiO_2 nanoparticles on the porous carbon and the influence of the photocatalytic properties. The samples prepared via mechanical mixing exhibit higher photocatalytic activity than the ones prepared via incipient wet impregnation. This is because TiO_2 particles are located on the surface of the carbon material in the former case, whereas a fraction of TiO_2 nanoparticles are placed inside the pores of the carbon support when prepared via incipient impregnation, thus preventing TiO_2 excitation by UV-A photons. This work shows that the hydrophobicity of the carbon matrix is a key feature for the photoactivity of the composites. Hydrophobic carbon/TiO_2 composites showed total removal of the pollutant studied at 1100 mL min^{-1} total gas flow in a one single pass photoreactor.

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