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Enhanced Photocatalytic Activities of TiO2/Ag2O Heterojunction Nanotubes Arrays Obtained by Electrochemical Method

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Abstract : During the last years, TiO2 nanotubes have been widely studied due to their unique highly ordered array structure, unidirectional charge transfer and higher specific surface area compared to conventional TiO2 powder. These photoactive materials, in the form of thin layer, can be activated by low powered and low cost irradiation sources (such as LEDs) to remove VOCs, microorganism and to deodorize air streams. This is possible due to their directly growth on a support material and high surface area, which guarantee enhanced photon absorption together with an extensive adsorption of reactant molecules on the photocatalyst surface. TiO2 nanotubes exhibit also lots of other attractive properties, such as potential enhancement of electron percolation pathways, light conversion, and ion diffusion at the semiconductor-electrolyte interface. Pure TiO2 nanotubes were previously used to remove organic compounds from the gas phase as well as in water splitting reaction. The major factors limiting the use of TiO2 nanotubes, which have not been fully overcome, are their relatively large band gap (3-3,2 eV) and high recombination rate of photogenerated electron–hole pairs. Many different strategies were proposed to solve this problem, however titania nanostructures containing incorporated metal oxides like Ag2O shows very promising, new optical and photocatalytic properties. Unfortunately, there is still very limited number of reports regarding application of TiO2/MxOy nanostructures. In the present work, we prepared TiO2/Ag2O nanotubes obtained by anodization of Ti-Ag alloys containing 5, 10 and 15 wt. % Ag. Photocatalysts prepared in this way were characterized by X-ray diffraction spectroscopy (XRD), scanning electron microscopy (SEM), luminescence spectroscopy and UV-Vis spectroscopy. The activities of new TiO2/Ag2O were examined by photocatalytic degradation of toluene in gas phase reaction and phenol in aqueous phase using 1000 W Xenon lamp (Oriel) and light emitting diodes (LED) as a irradiation sources. Additionally efficiency of bacteria (Pseudomonas aeruginosa) removal from the gas phase was estimated. The number of surviving bacteria was determined by the serial twofold dilution microtiter plate method, in Tryptic Soy Broth medium (TSB, GibcoBRL).

Keywords : photocatalysis, antibacterial properties, titania nanotubes, new TiO2/MxOy nanostructures
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