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TiO₂-based nanotubes for pollutants degradation

Photocatalytic reactions over solid semiconductors in the form of thin films or suspended nanoparticles (e.g., titanium dioxide) have been proposed as an antigramment friendly and the semiconductors in the form of the semiconductors in the semiconductors in the semiconductors in the form of the semiconductors in the form of the semiconductors in th dioxide) have been proposed as an environment-friendly process for removing pollutants from gas and liquid streams. Among other photocatalysts, ordered TiO, nanotube (NT) arrays have attracted increased attention due to their high surface area, good adsorption ability, highly ordered array structure, open mesoporous nature, excellent corrosion resistance, stable physical-chemical properties and unique ability to photooxidize organic compounds. Considering their unique properties, NTs can be used as photocatalytic materials; however, the low visible light utilization and high recombination rate of photoexcited electron-hole pairs limit their applications. The photocatalytic activity of TiO₂ under visible light can be achieved via loading metal nanoparticles (NPs) onto NTs, dye sensitization, hetero-coupling and doping. In this work, M_O_-TiO, mixed oxide nanotube layers (M=Ag, Cu, V, Co and Mn) were successfully prepared via one-step anodization of Ti-M alloys. The obtained samples were characterized by scanning electron microscopy (SEM), UV-Vis absorption, photoluminescence spectroscopy, energy-dispersive X-ray spectroscopy (EDX), X-ray diffraction (DRX) and micro-Raman spectroscopy. For the first time, the effect of the applied voltage (30-50 V), second metal content (5-15 wt.%) in the alloy and water content (2-10 vol.%) in an ethylene glycol based electrolyte was studied systematically to determine their influence on the morphology and photoactivity. The morphology of samples varied from sponge-like to highly-organized nanotubular. It was demonstrated that the anodic oxidation of Ti-Ag alloys led to the formation of TiO₂/Ag₂O NTs interlaced with silver NPs as in a cake with raisins. Silver NPs have been formed during the in situ generation of Ag ions and were (1) embedded in the NT walls, (2) stuck on the external NT walls, and (3) placed inside the NTs. The photocatalytic activity of the samples was evaluated by analyzing the degradation kinetics of phenol in aqueous phase and toluene in gas phase.

Biography

Adriana Zaleska-Medynska is a Professor in Chemical Technology at the University of Gdansk and Head of the Department of Environmental Technology. She has obtained her PhD in 2000 in the field of Chemical Technology at Gdansk University of Technology, Poland. Following appointment as a Visiting Scientist at University of Utah, USA and California Institute of Technology, USA, she was appointed as Adjunct Faculty of Chemistry at Gdansk University of Technology. She has completed DSc in Habilitation in 2009 and in 2012, she became the Head of the new research group at University of Gdansk followed by promotion to Full Professor at the same university in 2014. Her current interests concern functional material synthesis and characterization, heterogeneous photocatalysis, environmental technology, air treatment and nanotechnology.

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