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Modified ZnO nanoparticles thin films as a visible light photocatalyst for wastewater treatment

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Silver (Ag) and zinc oxide (ZnO) nanoparticles were simultaneously deposited on a glass substrate using the radio frequency (RF) sputtering technique at different substrate temperatures. Detailed characterization of the co-sputtered Ag/ZnO thin films were performed by X-ray diffraction (XRD), field emission scanning electron microscopy (FESEM) and X-ray photoelectron spectroscopy (XPS). The synthesized thin films were tested with UV-Vis diffuse reflectance spectroscopy to evaluate their optical properties. The obtained SEM results show a uniform dispersion of Ag nanoparticles within the ZnO matrix. These nanoparticles have average particle size of 20 nm. The optical band gap value had been calculated from UV transmission spectra of Ag/ZnO thin films deposited at various substrate temperatures. This value was observed to be in the visible light range (i.e. 2.7-3.1 eV), which is much smaller than that of pure ZnO (3.37eV). The photocatalytic activity of the produced thin films was evaluated through visible light photo degradation of 2-chlorophenol (2-CP) which, has been used as a pollutant model in water. The synthesized thin films showed enhanced visible light photocatalytic efficiency towards 2-CP degradation at elevated substrate temperature and retained its catalytic efficiency with only 8% loss in efficiency after four reuse cycles. Kinetic parameters involved in the degradation process were investigated by applying pseudo-second-order kinetic model.

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Pollutant toxicity and detoxification by humic substances: Mechanisms and assessment via luminescent biomonitoring

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Toxicity is defined as suppression of physiological functions of organisms. A variety of organisms are used as bioassays to monitor pollutant toxicity. Problems and perspectives of bioassay application for toxicity monitoring are discussed. Bioluminescent assays based on marine bacteria and their enzymes are of special attention; they are convenient tools to study mechanisms of toxic effects on cellular and biochemical levels. Advantages of bioluminescent assays for monitoring both integral and oxidative toxicities in complex solutions of pollutants and detoxifying agents are demonstrated. Bioluminescent bacteria were found to be sensitive to radionuclides; adaptive and toxic responses of the bacteria to radiation exposure are discussed. Effects of toxic compounds are multiple, they are integrated (by a non-additive way) in changing of bioluminescent intensity as a physiological function. Classification of effects of toxic compounds on bioluminescent assay systems is suggested based on broad investigations of model toxicants (organic dyes, oxidizers, halogenated molecules, metal salts, stable and radioactive). Seven mechanisms of physical, chemical, biochemical and cellular types are considered. Mechanisms of detoxification of pollutant solutions by water-soluble humic substances (HSs), natural detoxifying agents are discussed. Antioxidant properties of HS are considered in detail. The detoxifying effects of HS were shown to be complex and regarded as 'external' (binding and redox processes in solutions outside the organisms) and/or 'internal' organismal processes. The HS can stimulate an'internal' protective response of bacterial cells as a result of changes of rates of intracellular biochemical reactions and stabilization of mucous layers outside the cellwalls.

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