Nanostructured Metal-Oxide Electrode Materials for Water Purification

Metal oxide nanocomposites for adsorption and photoelectrochemical degradation of pharmaceutical pollutants in aqueous solution

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Abstract
The global deterioration of water quality which is associated with industrialisation, urbanisation, and a growing population is reaching critical levels and thus needs to be addressed urgently. Common pollutants that are discharged from industries and sewage plants include unknown toxic chemicals, heavy-metals and micro-organisms; these are well known and thoroughly studied. Of growing and great concern to both human and animal health is the new emerging class of pollutants known as endocrine disruptor chemicals (EDCs) or emerging organic compounds (EOCs); these are frequently associated with residues from pharmaceutical industries, i.e. they comprise of common drugs such as antibiotics, medication for chronic illnesses, pain killers. Regrettably, the traditional water purification systems cannot fully remove these pollutants, thus they are found in various water systems in minute concentrations. The danger is in the long run accumulative exposure to humans, animals and the environment. There are several methods that have been developed, reported and used for the removal of these pollutants. Several removal or remediation technologies have been studied and reported for the mineralisation of these emerging organic pollutants and of interest to this work is photocatalysis using light harvesting materials such TiO2 (i.e. semiconductors) and electrochemistry. The drawbacks associated with semiconductors are low quantum yields that emanate from rapid recombination of photo-generated electrons and holes with very low lifetimes. To overcome these drawbacks and to enhance degradation, an electrical external field can be applied across the catalyst or semiconductor to induce special separation of photo-generated electron hole pair to allow a sink for the electrons in a process called photoelectrochemistry. This chapter highlights the reported mineralisation of organic pollutants photoelectrochemistry using semiconductors; it also highlights the efficiency of photoelectrocatalysis when compared with photocatalysis alone.