OR0303

Deposition of narrow band semiconductor coatings by pulsed DC magnetron sputtering for visible light photocatalysis applications

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Titanium-dioxide-based photocatalysts have some major drawbacks that cannot be overcome at present. Firstly, the photocatalytic reaction rates are typically very low, which makes this technology not appropriate for high throughput processes, such as detoxification of highly polluted industrial waste or disinfection of heavily soiled surfaces. Secondly, only UV light can be utilized for activation of titania-based materials, which is less than 5% of solar spectrum. Therefore, there is an obvious need for development of novel efficient low band gap semiconductors that can be activated using visible light and thus provide an effective, environmentally friendly solution for water treatment.
Magnetron sputtering is a simple and versatile method used for the deposition of thin films, readily scalable and widely used in both laboratories and industrial production facilities, including production of photocatalytic coatings. In the present work several narrow band gap semiconductor coatings have been produced by pulsed DC magnetron sputtering and studied as potential alternatives to TiO_2-based photocatalysts. Thin films of bismuth complex oxides (molybdate and tungstate), tantalum oxynitride and nitride and cerium dioxide have been deposited onto variety of substrates and analysed by a range of methods, including SEM/EDX, XRD, TEM, XPS and Raman spectroscopy. The photocatalytic properties of the coatings were studied both under UV and visible light sources using dye degradation tests. The results of the photocatalytic tests were compared to a commercially available photocatalytic material.
The results of the study revealed that, with optimised deposition conditions, the narrow band gap semiconductors studied have potential as alternatives to traditional TiO_2-based photocatalysts, demonstrating visible light activity superior to a sample of commercial photocatayst. The influence of deposition conditions and post-deposition processing on photocatalytic properties are also discussed.

Keywords
photocatalysis
magnetron sputtering
semiconductors