PO4055

Structure and photocatalytic properties of Ti1-xWxO2 sputtered thin films

Grégory Abadias[1], Aldo Gago-Rodriguez[2], Nicolas Alonso-Vante[2]

[1]University of Poitiers, Chasseneuil-Futuroscope, France [2]LACCO, Université de Poitiers-CNRS, Poitiers, France

gregory.abadias@univ-poitiers.fr

The ability of titanium dioxide (TiO_2) compounds to generate electron-hole pairs under UV absorption has motivated many investigations due to its widespread applications in the energy and environment fields, such as antimicrobial, antifogging, or self-cleaning coatings, as well as for air or water purification and sterilization. In order to improve its photocatalytic activity in the visible-light spectrum, doping with metals as substitution for Ti cations or N or C as substitution for O has been used. Different routes can be selectively employed to achieve such doping, e.g., chemical, physical deposition processes, or ion implantation.

We report in the present work on the effect of W doping on the structure, phase stability and photocatalytic properties of TiO_2 thin films grown by magnetron sputtering. For this purpose, $Ti_{1-x}W_xO_y$ films with varying W contents between 0 and 0.5 were deposited by magnetron co-sputtering from Ti and W targets in either pure Ar or mixed Ar+O_2 plasma discharges on Si and on conducting glass substrates (SnO_2:F). For reactive sputtering, the characteristics of the sputtering mode were determined by recording the evolutions of the O_2 partial pressure and target voltage vs. O_2 flow. For both reactive and unreactive growth conditions, films were subsequently annealed at 550°C for 3h under vacuum or under air to promote phase crystallisation in the rutile or anatase structures, as characterized using X-ray Diffraction. While $Ti_{1-x}W_x$ alloys grown by unreactive sputtering were unstable after annealing, $Ti_{1-x}W_xO_y$ films grown by reactive sputtering crystallized after annealing in the rutile and anatase phases for low W contents, with a distorted lattice cell due to W incorporation. For larger W content, the formation of WO_3 phase was evidenced. The photoelectrochemical properties of the different films were further investigated in 0.5M H_2SO_4 and 0.1M NaOH electrolytes. It was found an enhanced activity for water electrolysis of low tungsten doping contents, such as x=0.18 in $Ti_{(1-x)}W_xO_2$ as compared to non doped TiO_2.

Keywords
TiO2
W doping
Sputtering