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Effect of temperature and amount of ag on tio$_2$ thin film synthesised via sol–gel method

Abstract

TiO_2 sol was produced via the sol–gel method with different amounts of $AgNO_3$ as the source of Ag. The Ag/TiO_2 thin film was obtained by spin coating and was annealed at various annealing temperatures (300°C, 400°C and 500°C) for 1 h. The effect of different amounts of $AgNO_3$ and different annealing temperatures on the TiO_2 thin films was studied by characterising the phase composition, surface morphology and water contact angle. Results from the x-ray diffraction (XRD) pattern show that with the addition of $AgNO_3$, Ag/TiO_2 can be formed at low annealing temperatures (300°C). At increased annealing temperatures (400°C and 500°C) and amounts of $AgNO_3$ (1.0 ml and 1.5 ml), Ag_2O and Ag_3O_4 phases were observed. Flakes or flaky islands were formed on the thin film due to thermal expansion mismatch between the film and substrate, residual stress within the film or the release of volatile species when annealed at a low temperature of $\sim$300°C. Increasing the temperature to 500°C resulted in the growth and coalescence of the flaky islands by the surface diffusion of adsorbed atoms (adatoms) and their annexation to the surface of existing nuclei. The water contact angle provides valuable insight into the surface interactions between water droplets and the surface of Ag/TiO_2 thin films. It was found that at 1.5 ml $AgNO_3$, the increased annealing temperature from 300°C to 500°C decreased the water contact angle of Ag/TiO_2 thin films from 83.86° to 34.62°, forming superhydrophilic properties, which indicated its excellent potential as a photocatalyst.

Keywords

Ag/TiO_2; anatase; annealing; photocatalytic; sol–gel; thin film