ABSTRACT

Titanium dioxide (TiO_2) is a wide band gap semiconductor that is widely used for different applications such as photo catalytic, solar cells, heterojunctions, gas sensors, memory devices, antireflection coatings etc. The effective use of the TiO_2 for these applications is associated with its optimum structural, electrical and optical properties that can be improved via different techniques. In this work TiO_2 film was deposited on n-type Si substrate at room temperature by direct current magnetron sputtering system. Post-deposition annealing of the TiO_2 film was carried out in the temperature range of 350-800 ºC for 90 min using a high temperature furnace. Structural characteristics of the film were investigated using X-ray Diffraction (XRD). The results of XRD showed amorphous nature of the as-deposited TiO_2 film. After annealing the film at 350 ºC, anatase phase of the film was appeared in the XRD pattern. By increasing the annealing temperature up to 800 ºC, crystallinity of the anatase TiO_2 was increased. The surface roughness of the TiO_2 film was investigated using Atomic Force Microscope (AFM). The results showed that the surface roughness of the TiO_2 film increased with increase of the annealing temperature. The increase in the surface roughness of the film was attributed to the increase in the crystallite size of the film. The band gap of the TiO_2 film was investigated using ultraviolet-visible reflectance spectroscopy analysis. The band gap of the film was decreased with increase of the annealing temperature. The decrease in the band gap was associated with the quantum size effect taking place in the material. Electrical properties of the TiO_2 film were investigated using Hall Effect measurements. Electrical resistivity was decreased, while, the carriers concentration increased with increase of the annealing temperature. The wettability of the TiO_2 film was studied using contact angle measurements. The results showed hydrophilic nature of the as-deposited film that remained unaffected after the annealing, however, the contact angle was decreased at higher annealing temperatures.