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Effect of Constant and Variable Temperature on the Morphology of TiO_2 Nanotubes Prepared by Two-Step Anodization Method

Authors : Tayyaba Ghani, Mazhar Mehmood, Mohammad Mujahid

Abstract : TiO_2 nanotubes are receiving immense attraction in the field of dye-sensitized solar cells due to their well-defined nanostructures, efficient electron transport and large surface area as compared to other one dimensional structures. In the present work, we have investigated the influence of temperature on the morphology of anodically produced self-organized Titanium oxide nanotubes (TiNTs). TiNTs are synthesized by two-step anodization method in an ethylene glycol based electrolytes containing ammonium fluoride. Experiments are performed at constant anodization voltage for two hours. An investigation by the SEM images reveals that if the temperature is kept constant during the anodizing experiment, variation in the average tube diameter is significantly reduced. However, if the temperature is not controlled then due to the exothermic nature of reactions for the formation of TiNTs, the temperature of electrolyte keep on increasing. This variation in electrolyte bath temperature introduced strong variations in tube diameter (20 nm to 160 nm) along the length of tubes. Current profiles, recorded during the anodization experiment, predict the effect of constant and varying experimental temperatures as well. In both cases, XRD results show the complete anatase crystal structure of nanotube upon annealing at 450 °C. Present work highlights the importance of constant temperature during the anodization experiments in order to develop an ordered array of nanotubes with a uniform tube diameter.

Keywords : anodization, ordering, temperature, TiO_2 nanotubes
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