The effect of heat treatment on phase transformation, morphology and photoelectrochemical response of short TiO2 nanotubes.

ABSTRACT

TiO2 nanotubes (TNT) have attracted considerable attention due to large specific surface area in a small geoetrical area and fewer interfacial grain boundaries. However, thermal stability and crystalline phase of TNT greatly affects their potential applications in the areas of photocatalysis, optoelectronics and gas sensing. Thus, thermal stability and phase transition of highly ordered TNT via calcination from 200-800 oC were studied in open air atmosphere. The results indicated that the as-anodized TNT is amorphous and transformed to anatase phase at 300 oC. Crystallization of anatase phase increases on elevating calcination temperature and rutile phase co-existed at 500 oC. No discernable changes in the nanotubes dimensions were found and TNT is thermally stable up to temperature lower than 600 oC, above which significant sintering of TNT occurred. At 800 oC, grain growth and oxidation of Ti resulted in completely collapsed of TNT to dense rutile crystallites. Photoelectrochemical response of calcined TNT enhanced substantially with respect to that of as-anodized samples and gradually increased with elevating temperature up to 500 oC after which they decreased, which was probably ascribed to changes in phase structural and morphological properties of TNT.

Keyword: Crystallisation; Heat treatment; Nanostructures; Oxides.