Investigation on optical and photoelectrochemical properties of self-assembled titania nanotube arrays prepared by anodization

ABSTRACT

Well ordered and vertically oriented titania nanotubes (TNT) are of great scientific interest due to their high surface area, fewer interfacial grain boundaries and excellent charge transfer between interfaces; all are critical properties in photoelectrochemical and photocatalysis application. In this study, self-assembled TNT electrodes were synthesized by anodization of pure Ti in 0.5 wt.% NH4F solution (NH4F/H2O), in mixture of aqueous-organic solution (NH4F/H2O/EG) and in an organic solution (NH4F/EG). Choice of electrolytic medium has an influence on the crystalline structure, regularity, elemental composition and band gap of TNT. All the samples showed a red shift and stronger absorption in the wavelength between 500-700 nm ascribed to the surface colour and increase crystallinity upon calcination. TNT formed in NH4F/H2O solution has the highest direct band gap of 3.34 eV due to quantization effect. From Liner Sweep Photovoltammetry analysis, the lowest photocurrent was recorded for TNT anodized in NH4F/H2O and a twofold and fivefold increase on the magnitude of photocurrent was obtained for those formed in NH4F/H2O/EG and NH4F/EG solution, respectively. Hence, highest photoefficiency of 2.79 % was recorded for TNT formed in NH4F/EG probably due to the formation of longer length tube.

Keyword: Anodization; Band gap energy; Nanotube; Photoefficiency; Titania