Fabrication and Characterization of Titanium Dioxide Nanotubes via Two-Step Anodic Oxidation Process

In the recent decades, nanotechnology has expeditiously advanced due to its promising assets and performance. Particularly, nanostructured titanium dioxide (TiO_2) has been a research focus because of its stability and versatile contributions in an extensive range of applications. In order to fabricate highly-ordered nanotube arrays, the key variables are to be optimized: the applied voltage and concentration of electrolytes. After performing mechanical and electrochemical polishing to ensure that the surface of the titanium substrate is cleared of large defects, the sample is run through a two-step anodization process, in which different potentials and two solutions (ethylene glycol with ammonium fluoride and monosodium phosphate with hydrofluoric acid) are tested. Images of the substrates taken with a scanning electron microscope (Hitachi S-3000N) reveal that after the first anodization, there are recognizable but disordered arrays with noticeable defects that can be greatly diminished by the second anodization. Analyzing the images, the structures are evidently most organized in the ethylene glycol/NH_4F electrolytes at 50 V, with nanotubes an average of approximately 124.42 micrometers in diameter, as compared to the nanotubes produced by the monosodium solution that had an average diameter of 74.98 micrometers. While the degree of ordering is not perfect, as the initial surface roughness significantly dictates quality, the hexagonal shape of the nanotubes is apparent, and the anodization processes greatly alleviate any defects and impurities. Synthesizing anodic titania nanotubes and refining this process has cogent potential to facilitate and promote future technological developments.