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Review Article

Fabrication of TiO2 Nanotube Thin Films and Their Gas Sensing Properties

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Abstract
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Abstract

The fabrication process and the growth mechanism of titanium/titania nanotubes prepared by anodization process is reviewed, and their applications in the fields of dye sensitized solar cells, photocatalysts, electrochromic devices, gas sensors, and biomaterials are presented. The anodization of Ti thin films on different substrates and the growth process of anodic titanium oxide are described using the current-time curves. Special attention is paid on the influences of the initial film smoothness on the resulted nanoporous morphologies. The "threshold barrier layer thickness model" is used to discuss the growth mechanism. As a case study for gas sensing, anodized highly ordered TiO2 nanotube arrays and nanoporous thin films that show porous surface with an average diameter of 25 nm and interpore distance of 40 nm were prepared. Gas sensors based on such nanotube arrays and nanoporous thin films were fabricated, and their sensing properties were investigated. Excellent H2 gas sensing properties were obtained for sensors prepared from these highly ordered TiO2 nanotube arrays, which present stable response even at a low operating temperature of 90°C. Based on our experimental results, "H-induced O2− desorption" mechanism was used for explaining the hydrogen gas sensing mechanism.