TiO_2 Nanotube Arrays for Sensing Applications

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Titanium dioxide (TiO_2) nanotubes have emerged as promising materials for gas sensing applications due to their high surface area and unique electronic properties. However, optimizing their synthesis for enhanced sensitivity remains a challenge. In this study, TiO_2 nanotubes were synthesized for use as an efficient gas sensing material for detecting ethanol by anodizing pure titanium (Ti) thin (~0.5 mm) foil pieces at varying voltages (60V, 70V, 80V). The structural characteristics of the synthesized TiO_2 nanotube arrays were analyzed using Scanning Electron Microscopy (SEM), revealing a variation in tube diameters from approximately 60 nm to 90 nm depending on anodization time (1 hour and 2 hours). The sample anodized for 2 hours at 60V and subsequently annealed at 450°C for 1.5 hours demonstrated a tube length of approximately 6 μm. Furthermore, this study details the design of the gas sensor circuit, the ethanol sensing chamber, and an Arduino-based temperature control system. The gas sensing performance of the TiO_2 nanotube-based sensor was evaluated under exposure to 1000 ppm ethanol, demonstrating the potential of this material for efficient alcohol detection.

Keywords: *TiO_2 nanotubes, semiconductor metal oxide, anodization, tube diameter, gas sensor*