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Promoted Hydrogen Gas Sensing of Nanostructured TiO2 Materials Prepared via Sputter Deposition

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1 Introduction

Hydrogen detection is hindered by sensors' low sensitivity and selectivity, necessitating advances in materials and techniques to enhance safety and efficiency. This study pioneers a novel helium-assisted sputter deposition technique for Cu-doped TiO_2 films, targeting enhancement of active surface area and improvement in sensing performance, Haviar et al. (2018)

2 Methodology

Cu-doped TiO_2 films were deposited using conventional DC magnetron sputtering, employing a circular titanium target with an adjacent copper strip in various working gas mixtures of Ar, He and O_2, maintaining a fixed total pressure of approximately 510 mPa. Where He partially replaced Ar and kept the total work pressure the same. After deposition, the samples were annealed at 500 °C for 4 hours in ambient air to crystallize and stabilize.

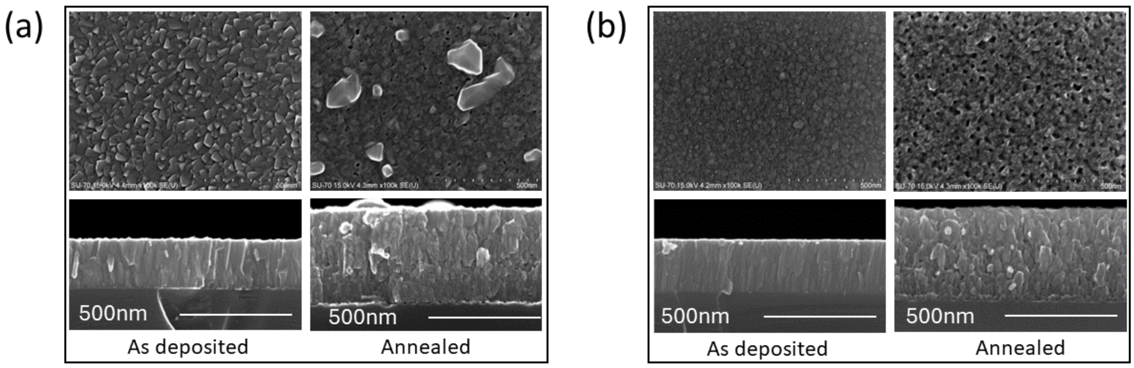

Figure 1: SEM micrographs (a) TiO_2 film in only in Ar (b) TiO_2 film in Ar and He mixture

3 Result

Structural characterizations using Scanning Electron Microscopy (SEM), EDS/WDS, X-ray diffraction (XRD), Raman and Atomic Force Microscopy (AFM) revealed morphological and crystalline changes due to helium-modified plasma sputtering. Figure 1(a) and (b) show The impact of helium introduction on the film microstructure, was examined through SEM and shows surface and cross-sectional morphology. The micrograph revealed a distinct columnar structure, showcasing the development of a porous microstructure, which leads to an increased

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surface area and subsequently enlarges the film's hydrogen adsorption capacity. X-ray diffraction pattern(XRD) confirms the successful growth of the TiO_2 lattice, which exhibited two phases, anatase, and rutile, and EDS Spectra, ensuring consistent Cu Concentration Across Samples. Sensing measurements were conducted using a four-point probe technique. Figure 2 illustrates The sample deposited with a mixture of He, Ar, and O_2 exhibited a significantly enhanced sensing response compared to the sample deposited with only Ar and O_2. This suggests that He increases the surface active area or porosity of the thin films, leading to improved sensing performance.

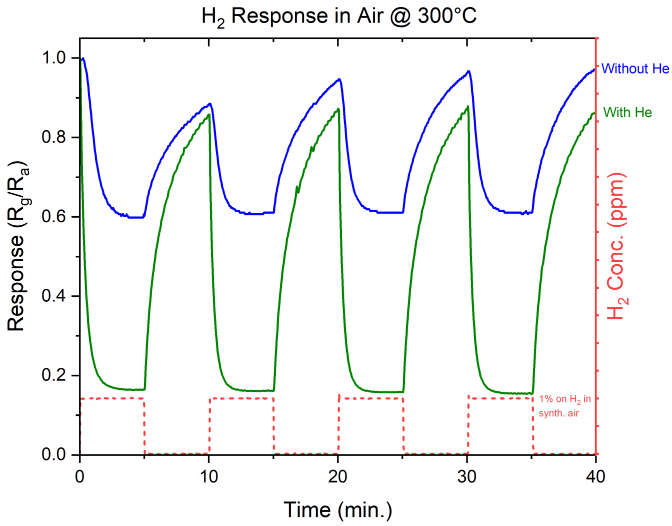

Figure 2: Response of TiO_2 Sensor to Argon and Argon-Helium Mixtures

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