Comparison of Thin Films of Titanium Dioxide Deposited by Sputtering and Sol–Gel Methods for Waveguiding Applications

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Received November 11, 2020
Revised November 11, 2020
Accepted for publication January 20, 2021

In this work, TiO_2 thin films were deposited onto glass substrate by two different techniques: sol–gel dip-coating (SG) and reactive DC magnetron sputtering (Sput). The prepared samples have been characterized by means of micro-Raman, differential scanning calorimetry (DSC), thermogravimetric analysis (TGA) measurements, scanning electron microscopy (SEM), UV-Visible spectrophotometry, and M-Lines spectroscopy (MLS). The micro-Raman results showed an amorphous TiO_2-SG phase and the vibrational mode of TiO_2-Sput is anatase phase. DSC-TGA analysis was used to investigate the thermal properties of the TiO_2 material. SEM spectroscopy has shown that TiO_2-SG has a disordered and more porous surface, TiO_2-Sput sample is homogeneous and shows uniform distribution of densely packed well-defined grains. The obtained films have an optical transmittance varying from 60 to 88% in the visible region. The optical band gaps deduced from the transmittance are 3.48 and 3.53 eV for TiO_2-SG and TiO_2-Sput, respectively. The optical waveguiding measurements carried out on TiO_2-SG and TiO_2-Sput films show single guided modes behavior (TE_0 and TM_0). These measurements have allowed deducing the refractive index and thickness values that are 2.06 at 216 nm for TiO_2-SG and 2.26 at 204 nm for TiO_2-Sput thin films. The analysis of waveguiding properties indicates that amorphous TiO_2 may prove to be more efficient in photonic device as compared to crystalline TiO_2.

Keywords: TiO_2, thin films, sol–gel, sputtering, anatase, waveguiding.

Full text of the paper will appear in journal SEMICONDUCTORS.