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Synthesis of VO2 thin films using an oxygen diffusion barrier

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Vanadium dioxide is a thermochromic material that presents an abrupt phase semi-conductor to metal transition at the temperature of 68 °C. Due to its narrow domain of stability, VO_2 requires an accurate flow rate of oxygen being delivered during the deposition.
In this work, a reactive sputtering process is proposed. An amorphous vanadium oxide thin film is deposited at ambient temperature and followed by an air annealing at the temperature of 350 °C. Although the annealing thin film exhibits an electrical and an optical transition close to 68 °C, X-Ray diffraction shows both under- and over-stoichiometric compounds (respectively, V_6O_{11} and V_4O_9 phases).
In order to assure a pure VO_2 phase elaboration, the literature proposes a post-annealing under vacuum. Another process consists of in-situ crystallization at high temperature using a heating substrate-holder with the appropriate oxygen rate.
We propose here a new way to reach a pure VO_2 thin film. We growth on the top of the film a SiO_2 thin layer which acts as an oxygen diffusion barrier and so protects the vanadium dioxide from oxidation during the annealing.
To improve the switching properties, various thicknesses of VO_2 were deposited and analysed. Crystallization and stoichiometry of the deposited vanadium dioxide thin films were checked by X-ray diffraction and EDS. Secondary ion mass spectrometry was used to confirm the interest of the silica layer about his protecting function regarding as the oxidation. Finally, the optical properties were studied using Fourier transformed infrared spectroscopy by doing reflectance measurement at varying temperatures.

Keywords
vanadium dioxide
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silica barrier
thickness