Exploration of VO_2 thin films with oxygen deficiency

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VO_2 has captured the attention of researchers due to its thermochromic properties and rapid semiconductor-to-metal transition. The semiconductor-to-metal shift occurs within the monoclinic M1 phase around 343K, coupled with a transformation from monoclinic to rutile crystal structure. The transparency of the monoclinic phase to near-infrared (NIR) radiation stands in contrast to the NIR opaqueness of the rutile phase. Maintaining precise stoichiometry in VO_2 is crucial, as even slight adjustments in oxygen levels can lead to the stabilization of different VO_2 polymorphs. Additionally, fine-tuning the stoichiometry offers a means of controlling the characteristics of VO_2. With this motivation, we have prepared stoichiometric and oxygen deficient VO_2 thin films on differently oriented sapphire substrates by radio frequency (RF) sputtering technique. The stoichiometric VO_2 thin films depicted characteristic semiconductor to metal transition around 343K. We noticed a complete suppression of semiconductor to metal transition in oxygen deficient VO_2 thin films and a metallic behavior was seen throughout the studied temperature range i.e. 273K to 373K. Oxygen deficiency led to significant modifications in the structural, electronic and optical properties of VO_2 thin films.

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