Transport Anisotropy of Epitaxial VO$_2$ films grown on (100) TiO$_2$

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STUART WOLF, Department of Physics, University of Virginia — Vanadium dioxide (VO$_2$) exhibits a metal semiconductor transition (MST) at 340 K. This transition is accompanied by the abrupt change in the electrical conductivity, optical transmittance and reflectance in infrared region, which can be used in the electronic devices such as temperature sensors and electric switches. In this study, Reactive Bias Target Ion Beam Deposition was used for epitaxial VO$_2$ thin film growth on TiO$_2$ (100) substrates. The out-of-plane and the in-plane XRD scans have been performed to confirm the single phase VO$_2$ and the epitaxial relationship between the film and the substrate. The hall bars along the in-plane c-axis and b-axis of R-VO$_2$ were fabricated via the photolithographic process. It is found that the maximum conductivity was parallel to c-axis, while the minimum conductivity was parallel to b-axis. The conductivity anisotropy persisted through the metal semiconductor transition. The conductivity anisotropy ratio $\sigma_c/\sigma_b$ was found to be $\sim$16.2 at 300 K, much larger than that of single crystal VO$_2$. The temperature dependent anisotropy of the carrier concentration and the mobility is to be discussed.