Abstract Submitted
for the TSF11 Meeting of
The American Physical Society

Effect of free-carrier concentration on the phase transition and vibrational properties of VO_2 MOHAMMAD NAZARI, CHANGHONG CHEN, AYRTON BERNUUSI, ZHAOYANG FAN, MARK HOLTZ, Texas Tech University — Vanadium dioxide (VO_2) shows a reversible first-order phase transition from low monoclinic semiconductor phase (M1) into high temperature tetragonal metallic rutile phase (R) near temperature 340 K. The metal-insulator transition is accompanied by 4-5 orders of magnitude change in the electrical resistivity and an abrupt change in the optical properties. The effects of native defect doping concentration on the phase transition properties of vanadium dioxide thin films are investigated. The onset temperature of the metal-insulator transition is found to depend on the free-carrier concentration and to correlate with an abrupt change in the temperature dependence of the vibrational energies of the V-O related vibration. Raman scattering study at different temperatures (20-80 $^\circ$C) shows the V-O related phonon band at $\sim$614 cm^{-1} behaves differently from the other Raman bands. The dependence of this band on temperature is found to vary for VO2 with different hole concentrations. Based on Raman and electrical resistance measurements, a phase diagram is proposed identifying insulating, intermediate, and conducting regimes. The intermediate region is attributed to a mixed metallic/insulating phase.

Mohammad Nazari
Texas Tech University

Date submitted: 12 Sep 2011 Electronic form version 1.4