Abstract Submitted
for the MAR17 Meeting of
The American Physical Society

Mechanical Control of Metal-Insulator Transition in Epitaxial Vanadium Dioxides YOGESH SHARMA, CHANGHEE SOHN, JOHN NICHOLS, QIAN LI, NINA BALKE, PANCHAPAKESAN GANESH, JANAKIRAMAN BALACHANDRA, OLLE HEINONEN, HO NYUNG LEE, Oak Ridge National Lab — Strongly correlated vanadium dioxide (VO_2) is one of the most promising materials exhibiting a temperature-driven metal-insulator transition (MIT) in the vicinity of room temperature. Thus, establishing control over the MIT of VO_2 by means of external stimuli, such as strain, temperature, and electric field, is an important task to realize VO_2-based advanced electronic devices. Herein, we explore the mechanical control of the conductivity and hence the MIT in epitaxial VO_2 thin films using electronic transport and scanning probe microscopy approaches. We found that the mechanical pressure could modulate VO_2 film's conductivity. This result is attributed to the piezochemical effect as oxygen stoichiometry is strongly influenced by the applied mechanical pressure. This piezochemical coupling is further realized by observed shifts in electrochemical potential of oxygen vacancies as a function of applied pressure and electric field. We relate our results to calculations of oxygen vacancy formation energy as function of pressure. Such strain-induced changes in electrochemical potential and conductance of VO_2 films indicate the local pressure-induced MIT, and can be explained based on the flexoelectric effect and/or Vegard strain effect. Our findings provide the basis for piezochemical control of MIT in VO_2 thin films.

Yogesh Sharma
Oak Ridge National Lab

Date submitted: 20 Nov 2016 Electronic form version 1.4