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Modulation of single-crystal vanadium dioxide film by hydrogen HENG JI, Department of Physics and Astronomy, Rice University, WILL HARDY, Applied Physics Graduate Program, Rice Quantum Institute, HANJONG PAIK, DARRELL SCHLOM, Department of Materials Science and Engineering, Cornell University, DOUGLAS NATELSON, Department of Physics and Astronomy, Rice University — Vanadium Dioxide is a strongly correlated material with a bulk metalto-insulator transition at 340 K. This transition temperature can be affected by strain, and previous experiments in single-crystal nanowires (J. Wei et al., Nature Nano. 7, 357-362 (2012)) have shown that catalytic doping with atomic hydrogen can stabilize the high temperature metallic state. In this experiment, we examine the effects of hydrogen on a 10 nm thick VO_2 film grown on TiO_2 (001) substrate by MBE with a transition temperature at 280K. We found the transport properties of this film can be dramatically modulated by doping and releasing hydrogen in and out of VO2 film even at room temperature. The resulting changes in the conductivity are even more dramatic than those seen in nanowires. The enhanced rate of response at room temperature is likely aided by the crystallographic orientation of the film, which has a growth direction along which hydrogen is known to diffuse rapidly in rutile TiO_2 , which is isostructural to the metallic VO_2 high temperature phase.

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