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Three Dimensional Infrared Nano-Imaging of Stripe Order in Vanadium Dioxide MENGKUN LIU, MARTIN WAGNER, Department of Physics, University of California, San Diego, JINGDI ZHANG, Department of Physics, Boston University, ALEXANDER MCLEOD, Department of Physics, University of California, San Diego, SALINPORN KITTIWATANAKUL, Department of Physics, University of Virginia, ZHE FEI, Department of Physics, University of California, San Diego, ELSA ABREU, Department of Physics, Boston University, MICHAEL GOLDFLAM, AARON STERNBACH, SIYUAN DAI, Department of Physics, University of California, San Diego, KEVIN WEST, JIWEI LU, STUART WOLF, Department of Materials Science and Engineering, University of Virginia, RICHARD AVERITT, Department of Physics, Boston University, D.N. BASOV, Department of Physics, University of California, San Diego — We report the three dimensional landscape of the stripe state in vanadium dioxide (VO_2) films. This is achieved via direct visualization with scattering-type scanning near-field optical microscope (s-SNOM) [Phys. Rev. Lett. 111 (9), 096602 (2013)]. The VO_2 films we investigate in this study are epitaxially grown on $[100]_R$ TiO_2 substrates and exhibit uniaxial strain induced cracking uniformly along the rutile c axis. With s-SNOM, we show that (1) monoclinic-tetragonal crystal symmetry, (2) in-plane rotational symmetry and (3) out-of-plane (z-axis) symmetry have been spontaneously broken in the vicinity of the phase transition. Our results demonstrate s-SNOM as a powerful approach for bringing new insight into mesoscopic physics in strained metal oxide thin films.

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