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An ultrafast nano-infrared study of the photo-induced insulator-to-metal transition in Vanadium Dioxide AARON STERNBACH, University of California San Diego Department of Physics, MENGKUN LIU, University of California San Diego Department of Physics, Stony Brook University Department of Physics, MARTIN WAGNER, RUBEN IRAHETA, University of California San Diego Department of Physics, TETIANA SLUSAR, University of Science and Technology School of Advanced Device Technology, Metal-Insulator Transition Creative Research Center ETRI, ALFRED LEITENSTORFER, University of Konstanz, Center for Applied Photonics, HYUN-TAK KIM, University of Science and Technology School of Advanced Device Technology, Metal-Insulator Transition Creative Research Center ETRI, RICHARD AVERITT, DIMITRI BASOV, University of California San Diego Department of Physics — We have devised and implemented the technique of time resolved scanning near-field optical microscopy to study the inhomogeneous development of a phase transition in the time domain with 20 nanometer spatial resolution and 100 femtosecond temporal resolution. The subject of our study is Vanadium Dioxide (VO_2), which is a canonical correlated electron system that exhibits an insulator to metal transition (IMT). We observe an abrupt rise in the photoconductivity at several hundred femtoseconds followed by a slow rise, which takes place on the order of several hundred picoseconds. Our measurement resolves the rise time of the IMT in individual sites, and we further observe inhomogeneous dynamics that are dependent on local strain. Our results pave the way for studying a plethora of systems where phase transitions involve inhomogeneities and phase separation.

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