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Photoinduced phase transitions in vanadium dioxide revealed by ultrafast electron diffraction and mid-infrared spectroscopy[1] KUNAL TIWARI, VANCE MORRISON, ROBERT CHATELAIN, McGill University Department of Physics, ALI HENDAOUI, Institut National de la Recherche Scientifique, ANDREW BRUHACS, McGill University Department of Chemistry, MOHAMED CHAKER, Institut National de la Recherche Scientifique, BRADLEY SIWICK, McGill University Departments of Physics and Chemistry — The complex interplay between strong electron-electron correlations and structural distortions is thought to determine the electronic properties of many oxides, but the respective role of these two contributions is often difficult to determine. We report combined radio-frequency compressed ultrafast electron diffraction (RF-UED) and infrared transmissivity experiments in which we directly monitor and separate the lattice and charge density reorganizations associated with the optically induced semiconductor-to-metal phase transition in vanadium dioxide. These studies have uncovered a previously unreported photoinduced transition to a metastable phase retaining the periodic lattice distortion characteristic of the insulating phase, but differing by a reorganization of charge density along the vanadium dimer chains and a transition to metal-like mid IR optical properties. These results demonstrate that UED is able to follow details of both lattice and electronic structural dynamics on the ultrafast timescale.

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