DREXEL UNIVERSITY
Materials Science and Engineering
College of Engineering

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Tracking the Evolution of the Ultrafast Metal-Insulator Transition in VO2

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Abstract

VO2 exhibits an ultrafast (uf) insulator-to-metal transition from an insulating monoclinic phase to a metallic rutile phase at 340 K. Measurements also show the transition occurs on the sub-picosecond timescale and undergo a change in electrical conductivity of up to five orders of magnitude. These characteristics make VO2 a promising material for use in THz ultrafast switch design. However, while the transition has been studied extensively since it's discovery nearly sixty years ago, the underlying physics at play throughout the dynamic itself have been debated back and forth for over four decades. The practical application of VO2 in future uf switch design is dependent on whether the transition is driven by electronic correlation or limited to the timescale of atomic motion.

Taking advantage of the photoinduced MIT transition in VO2 in tandem with ultrafast techniques provides a unique avenue into uncovering the nature of VO2's dual transition by allowing one to observe the electronic and lattice transition independently on the timescales that they occur. This presentation reviews the available ultrafast literature to track the evolution of the transition for signs of the inherent mechanism that drives the transition and the limiting factors which would cap the transition time.