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Electrochemically Induced Insulator-Metal-Insulator Transformations of Vanadium Dioxide Nanocrystal Films DELIA MILLIRON, CLAYTON DAHLMAN, GABRIEL LEBLANC, AMY BERGERUD, University of Texas at Austin — Vanadium dioxide (VO2) undergoes significant optical, electronic, and structural changes as it transforms between the low-temperature monoclinic and high-temperature rutile phases. The low-temperature state is insulating and transparent, while the high-temperature state is metallic and IR blocking. Alternative stimuli have been utilized to trigger insulator-to-metal transformations in VO2, including electrochemical gating. Here, VO2 nanocrystal films have been prepared by solution deposition of V2O3 nanocrystals followed by oxidative annealing. Nanocrystalline VO2 films are electrochemically reduced, inducing changes in their electronic and optical properties. We observe a reversible transition between infrared transparent insulating phases and a darkened metallic phase by in situ visiblenear-infrared spectroelectrochemistry and correlate these observations with structural and electronic changes monitored by X-ray absorption spectroscopy, X-ray diffraction, Raman spectroscopy, and conductivity measurements. Reduction causes an initial transformation to a metallic, IR-colored distorted monoclinic phase. However, an unexpected reversible transition from conductive, reduced monoclinic VO2 to an infrared-transparent insulating phase is observed upon further reduction.

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