Tunable Metal–Insulator Phase Transition in VO$_2$ Nanowires

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Understanding the thermodynamics and structural transformation during the Metal-Insulator Transition (MIT) is critical to better understand the underlying physical origin of phase transition in the vanadium dioxide (VO$_2$). Here, through the temperature-dependent in-situ high resolution-transmission electron microscopy (HR-TEM), and systematic electrical transport study, we have shown that the tunable MIT transition of VO$_2$ nanowires is strongly affected by interplay between strain and domain nucleation by ion beam irradiation. Surprisingly, we have also observed that the VO$_2$ rutile (R) metallic phase could form directly in a strain-induced metastable monoclinic (M2) phase. These insights open the door toward more systematic approaches to synthesis for VO$_2$ nanostructures in desired phase and to use for applications including ultrafast optical switching, smart window, metamaterial, resistance RAM and synapse devices.

Keywords: phase transition, VO$_2$, TEM