

## Atomic Resolution Study of W-Doped VO<sub>2</sub> Nanowires

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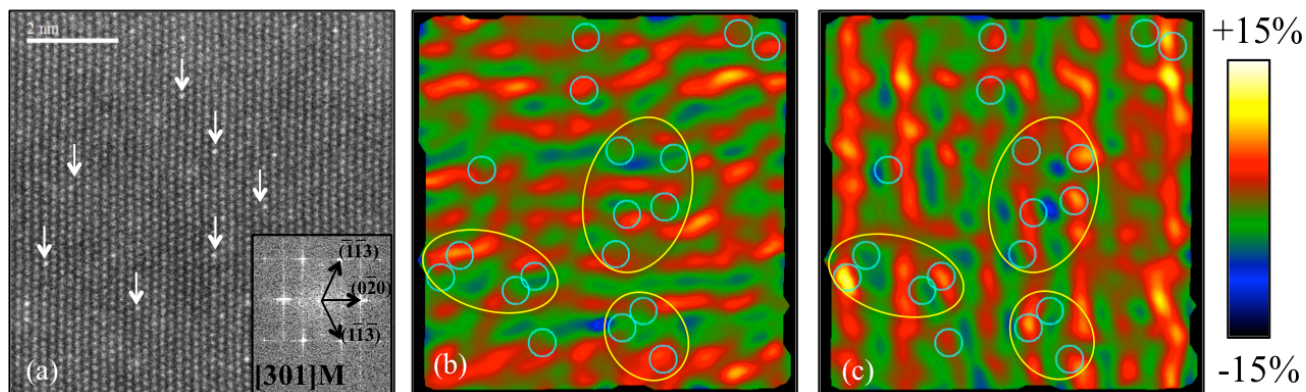
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Metal-Insulator Transition (MIT) in VO<sub>2</sub> has attracted attention of many theorists and experimentalists for more than fifty years since the discovery of the phenomena by Morin [1]. The distinctive aspects of this phenomena are structural phase transition, sharp resistivity and optical transparency changes by several order of magnitudes at ~ 340 K [2]. These distinctive properties have inspired many applications such as thermo/electrochromics, Mott transistors, memristors, thermal actuators, gas sensors, strain sensors and temperature sensors. Recent efforts focus on controlling of phase transition and domain structures in finite size VO<sub>2</sub>, which results in different material properties and play a critical role in device applications.

In this work, we have focused on the effect of tungsten (W) dopant in MIT of individual single-crystalline VO<sub>2</sub> nanowires by use of aberration corrected scanning transition electron microscopy. The high-resolution Z-contrast imaging of individual single-crystalline W<sub>x</sub>V<sub>1-x</sub>O<sub>2</sub> nanowires indicates W dopant atoms in the structure as shown in Figure 1a. The strain map analysis of high-resolution images reveals the effect of dopants in MIT of VO<sub>2</sub> (Figure 1b-c). The dopants create anisotropic stress and structural distortions into the VO<sub>2</sub> structure. This stress facilitates the phase transition from monoclinic structure to tetragonal structure. We also verified the experimental observation by Density Functional Theory (DFT) calculations.

## References:

- [1] FJ Morin, Phys Rev Lett **3** (1959), p. 34.  
 [2] V Eyert, Ann Phys (Berlin) **11** (2002), p. 650.



**Figure 1.** (a) Atomic resolution HAADF image of  $W_xV_{1-x}O_2$  nanowires. Insets correspond to the FFT of (a) which indicates that (a) has been acquired along the  $[301]$  zone axis of the monoclinic structure. The spots with higher intensity imply the existence of W in each column as compared to other spots. (b-c) strain maps relate along to and perpendicular to  $(\bar{1}\bar{1}3)$  lattice planes.