Local Structure Investigation of Rapidly Synthesized $W_xV_{1-x}O_2$

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Vanadium dioxide (VO_2) has been widely studied, in part, due to it's near room temperature phase transition[1][2]. Below the transition temperature, 68°C, VO_2 is a semiconducting monoclinic phase, $P2_1/c$; whereas, above 68°C, it is a metallic tetragonal phase, $P4_2/mnm$. Substituting vanadium with 3d and 4d transition metals allows tunability of the phase transition temperature[3][5][4]. Conventional furnace synthesis requires multiple days to achieve phase purity. A microwave-assisted synthesis is presented which decreases synthesis time by four orders of magnitude, from days to minutes. Tungsten substitution amount has been verified through inductively coupled plasma mass spectrometry. Differential scanning calorimetry and superconducting quantum interference device measurements confirms that the transition temperature decreases with increasing tungsten amount. Synchrotron powder x-ray diffraction and Rietveld analysis verifies phase purity. The Rietveld analysis uncovered the phase fraction of un-substituted vanadium dioxide. Boxcar fitting of in-situ heating total scattering data analyzed with the pair distribution function determined whether there is a time difference between the change in the local and average structure during phase transformation.

References

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