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In situ study of phase transformations and phase equilibria in the tantala and hafnia binary system

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IN SITU STUDY OF PHASE TRANSFORMATIONS AND PHASE EQUILIBRIA IN THE TANTALA AND HAFNIA BINARY SYSTEM

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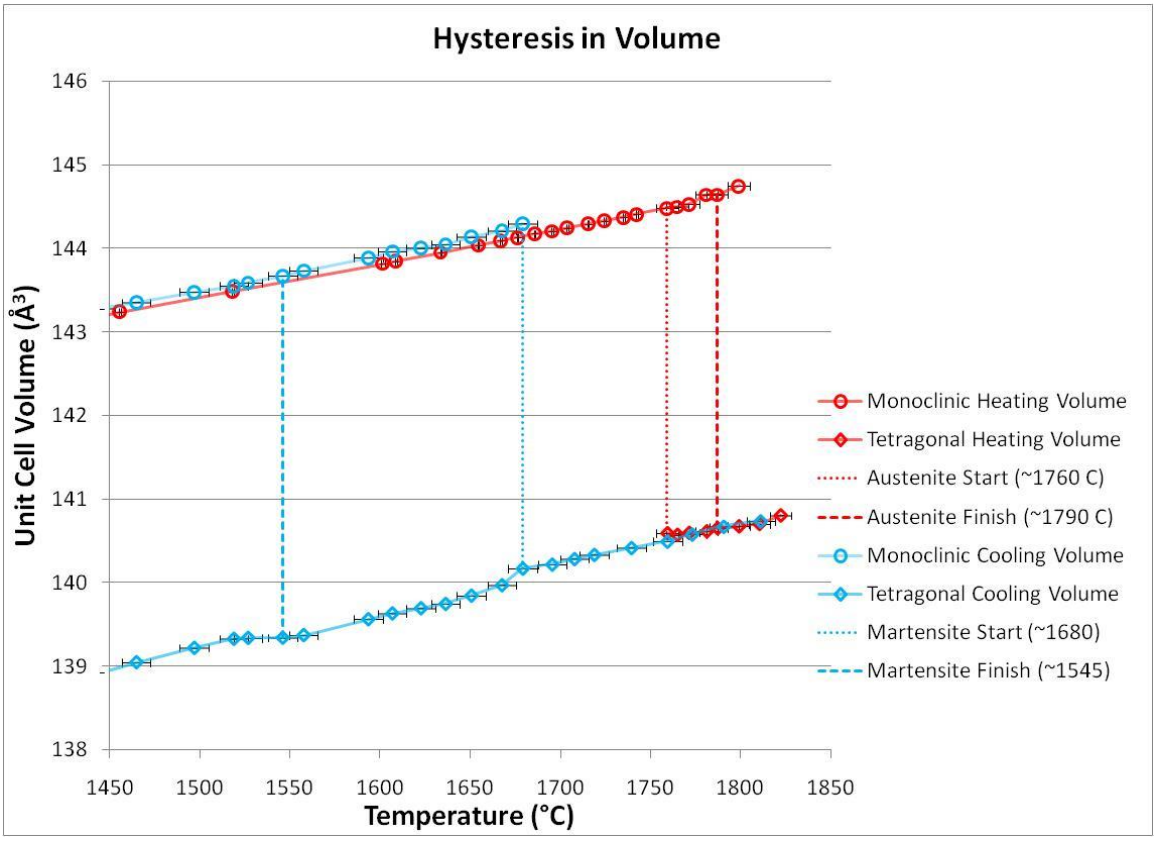
Abstract

Tantala (Ta_2O_5) has useful dielectric, optical, catalytic and chemical properties while hafnia (HfO_2) has found applications as a high temperature structural ceramic. Tantala and hafnia ceramics have yet to be studied in detailed. During this study, the Ta_2O_5-HfO_2 binary system was investigated using high temperature x-ray diffraction from room temperature to 1650˚C in air using synchrotron radiation. The crystal structures of Ta_2O_5, HfO_2 and $Hf_6Ta_2O_{17}$ were examined with their corresponding phase transformations and 3-D thermal expansions.



In situ synchrotron study of the monoclinic to tetragonal transformation on heating in hafnia (HfO_2) showing a volume decrease on heating (red) as well as a volume increase and hysteresis on cooling (bleu).

$$\frac{\Delta V}{V_0} = -2.73 \pm 0.04\% \qquad \frac{\Delta V}{V_0} = 2.99 \pm 0.06\%$$