

The Effect of Pressure on the Transition of ZrO_2

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Abstract

The effect of pressure on the monoclinic-tetragonal reversible transition of ZrO_2 was investigated. The pressure dependency of the above transition was estimated to be $dT_c/dP = -3.02 \times 10^{-2}$ deg.bar⁻¹ from the thermodynamic data of ZrO_2 by Whitney. As the experimental result has not been obtained yet, the experiment of the pressure effect on this transition was tried, to compare it with the calculated value.

A Kennedy type piston-cylinder high pressure apparatus was used and the transition points were detected by the electrical resistance measurement of ZrO_2 under high temperatures and high pressures.

The measurements were carried out in the temperature and pressure ranges up to 1300°C and 30 kb, respectively.

One sample of ZrO_2 used in the present experiment is the ZrO_2 powder obtained by Monsanto Chemical Co. Using the above sample, the transition point and the molar volume change were measured by High temperature X-ray diffraction at the atmospheric pressure. The monoclinic-tetragonal transition point $T_c^{M \rightarrow T}$ was 1140°C and the molar volume change $\Delta V^{M \rightarrow T}$ was $-0.95 \text{ cm}^3/\text{mol}$. As the entropy change, $S^{M \rightarrow T}$, the value by Coughlin and King was used, which is $S^{M \rightarrow T} = 0.96 \text{ cal/mol.deg}$. Using the Clausius-Clapeyron equation, the pressure effect on the transition was calculated to be -1.2×10^{-2} deg.bar. On the other hand, the pressure dependency of the transition point obtained by the experiment was -1.6×10^{-2} deg.bar.