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Phase boundary between rutile-type and $CaCl_2$-type germanium dioxide determined by in situ X-ray observations

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ABSTRACT

In situ synchrotron X-ray experiments of the GeO_2 system were made at pressures of 28–45 GPa and temperatures of 300–2300 K, using a diamond anvil cell combined with a laser heating and a 6–8 type multianvil high-pressure apparatus. We observed a second-order phase transition between tetragonal rutile-type ($P4_2/mnm$) and orthorhombic $CaCl_2$-type ($Pnnm$) phases under high pressure and temperature. The transition kinetics seem to have little effect on the second-order phase transition because the cell constants exhibit no discontinuities between the phases. Therefore, the phase transitions could be observed at low temperature conditions in this study. The phase boundary was determined to be P (GPa) = (34.9 ± 1.2) + (0.0086 ± 0.0024) × (T – 1300) (K).