Effect of chemical composition on the pressure-induced coordination number change in liquid germanate

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Structures of liquid silicates, in particular their responses to compression, are of great interest for geophysics. However, the experimental study of structural change of liquid silicates is difficult because extreme pressures and temperatures are needed and the number of in-situ technique for observing liquid structure is restricted under such conditions.

It is well known that germanates are structural analogs of silicates. Our previous high-pressure XAFS study has shown that a dense liquid phase with GeO6 octahedron appears in Li2Ge4O9 melts under pressure. However the transition mechanism and the effects of chemical composition have not been clearly understood. In this study, using a high-pressure and high-temperature XAFS technique, we have investigated effects of chemical composition on the pressure-induced coordination number change in liquid germanate.

High-pressure and high-temperature XAFS experiments were performed at a beamline BL14B1 of SPring-8. Pressure was generated by using a cubic-type multianvil press installed on the beamline. In situ XAFS measurements were conducted in transmission mode. XAFS spectra near Ge K edge with an energy range of 1000 eV above the edge were successfully measured up to 10 GPa at 1500 K. The extended X-ray absorption fine structure (EXAFS) interference function was extracted from measured XAFS spectra using standard procedure.

We obtained the variation of the first neighbor Ge-O distances in liquid SrGeO3 up to 10 GPa and 1500 K. It is interesting that pressure dependences of the Ge-O distances in liquid SrGeO3 containing B2O3 and the liquid SrGeO3 containing H2O2 show similar trend at high-pressure region. This indicates that there would be less effect of coexisting ions on the local structural change around Ge.