Development of the new technique to identify the phase boundaries of aqueous solutions for understanding the internal structures of icy bodies

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Recently, many direct or indirect evidences which infer the existing of subsurface oceans under the icy crusts of icy bodies have been reported. However their detailed structure and evolution have been never determined definitely for a few reasons. One of them, we can raise the lack of knowledge about the phase diagrams of aqueous solutions as a main constituent in the subsurface ocean, with which we can directly constrain the internal structures of icy bodies by thermodynamic considerations.

In this study, we developed the new technique which can detect the phase change in saline-water system under the condition supposed inside of icy bodies by measuring their dielectric properties and magnetic susceptibilities. Dielectric measurements are effective approach to identify the phase boundary because H2O is polar molecule (Whalley et al.,1966). So we apply this method to identify the solid-liquid and solid-solid boundary of saline-water system under high pressure conditions. We have achieved to observe the solid-liquid boundaries of pure water and NaCl solution under ambient pressure. We applied this method to observe the solid-liquid boundary under high pressure.

We will finally develop the simultaneous measurement of magnetic susceptibility and dielectric property to realize more accurate identification of phase boundaries.

We used SQUID magnetometer MPMS-7(Quantum Design Inc.) for susceptibility measurement. This instrument is able to measure the magnetization of samples in the temperature range of 1.8K-400K. We enclose the liquid sample in the cylindrical PTFE cell(3mm, height10mm), and generate high pressures using a piston cylinder-type small pressure cell specifically designed for MPMS.

For dielectric measurement, we employed three terminal capacitance bridges. Temperature control and pressure generating system are same as susceptibility measurement. So we will design the circuits capable of placing inside MPMS piston cylinder to perform a simultaneous measurement.
We will report the detailed configuration of experiments and results of measurements in our poster.

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