Development of a heating stage for in-situ observation of bubble growth in silicate melt

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The oxygen fugacity controllable heating stage was developed. This heating stage was developed in order to carry out in-situ observation of the bubble growht in silicate melt. The unique features of this heating stage are that oxygen fugacity control can be performed and that observation is possible with transmitted illumination

Oxygen fugacity control is indispensable for melting experiments for earth's and planetary materials. The environment of inside of the earth and bodies other than the earth is also reproducible with fugacity control. In order to conduct bubble growth experiment invoked by crystal growth, the oxygen fugacity in which the ferrous iron does not oxidize must be maintainable for several hours. For oxygen control, a gas blender geneates the mixed gas of hydrogen gas and carbon dioxide gas, and it sends into a heating stage. Although a the heating stage is maintained airtightness. Although there is little flux of mixed gas, the capacity of a heating stage is about 8 liter. In order to drive out internal oxygen rapidly, Ar gas is poured into a heating stage at the maximum rate 2 liter per minute befor experiment.

Transmitted illumination. is also an element important for the observation. Using reflected illumination, reflection of the surface of melt is strong and serves as an obstacle of observation. In order to realize transmitted illumination, window are attached to the upper and lower sides of the heating stage Each window has three kinds of glasses. An inside window is silica glass. It can be exchanged easily, when it reacts with internal gas and lose its transparency. Infrared reflective glass is used for the middle part and reduces the heat flow from a heating stage to the exterior. Infrared absorption glass is used at the most outer side and avoids the overexposure by infrared rays in using a CCD camera (there is sensitivity at infra-red).

An core tube of the furnace, 12 mm in inside diameter, is made of a heat insulating material. A heating element is a platinum wire or a platinum rhodium alloy wire. The core tube also plays the role to support the wires because the wire became weak at high temperature. The core tube is surrounded by fire-resistant heat insulating materials. Practical use temperature amounts to 1500 degrees C. Silica glass and sapphire glass are put between upper and lower core tubes, and samples are loaded on the glass. Owing to this structure, observation by transmitted illumination. can be performed. Since the heating stage is cooled by water current, we can touch the heating stage during experiments.

A stereoscopic microscope is used for observation. In order to reduce the temperature gradient near the sample in the heating stage, the height of a heating stage is set 20 cm. Because of this, the long working distance of stereoscopic microscope is necessary. The microscope is set as inverted position. Owing to this structure, operation of a heating stage become easier. Moreover, even when bubbles are accumulated on the surface of the melt of low viscosity, we can observe the interior of the melt from the bottom. The microscope has a CCD camera.and a high-speed camera (500flames/s) for recording bubble growth.

Five signal lines for thermo couples, two power lines for heating, and two multi-purpose signal lines are wired on the heating stage. The multi-purpose signal lines will be used in the future for measurements of various physical quantities incidental to bubble growth such as acoustic measurement etc.