IN-SITU OBSERVATION OF GROWTH AND DISSOLUTION PROCESSES AT ELEVATED TEMPERATURES

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This paper reports the instrumentation of the systems for in-situ observation of growth and dissolution processes at elevated temperatures (≈1800 K). Needless to say, instrumentation of such systems will provide very powerful methods in the studies of both basic sciences, like magmatic crystallization, and applications, like semi-conductor industries, since in-situ observations of growth and dissolution processes provide a direct evidence in understanding growth and dissolution mechanisms, crystal perfections, and the state of solid-liquid interfaces, etc.

The proto-type of in-situ observation system has been reported previously. Since then, we have developed 3 other types. The in-situ observation systems we developed in our laboratory essentially consist of the following equipments (Fig. 1).

1. Optical microscope by transmitted illumination, with phase contrast or polarization equipments,

2. an aberration corrected objective lens for the observation through a thick liquid and a quartz glass,

3. high temperature furnaces workable on the microscope stage, where a high temperature liquid film is held on a Pt–Rh loop, 5 mm φ, (Fig. 2) and

4. a temperature controller using a highly stabilized digital system with fluctuation less than 0.3°C at 1600°C.

With this set up, various phenomena relating growth and dissolution can be investigated in-situ under well controlled conditions, and growth or dissolution rate can be measured precisely. Such phenomena include metastable nucleation, roughening transition of solid-liquid interface and its anisotropy, morphological changes in relation to the supercooling and the compositions, etc, some of which are reported as posters during this Seminar.

By applying Schlieren method to this system, the state of liquid phase, like diffusion boundary layers and convections can be investigated as well.
FIG. 1. Total system.

FIG. 2. Growth cell.
Fig. 3. Morphological change of forsterite depending on supercooling, ≈ 1400°C.

Fig. 4. Growing diopside crystal by polarization microscopy using a monochromatic light.

Further applications are being planned which include the followings.
(1) Instrumentation of a furnace workable under higher pressure, to investigate phases containing compatible components.
(2) In-situ element analyses of a solution just near a growing crystal by the use of spectroscopy and laser scattering.

REFERENCES