

Fabrication of albite aggregate by hot pressing

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Feldspar is one of the main constituent minerals of the Earth's crust. The mechanical behavior of plastic deformation of feldspar has previously well studied especially for anorthite ($\text{CaAl}_2\text{Si}_2\text{O}_8$), because this controls the strength of the lower crust. On the other hand, several studies of natural fault rocks and experimental results suggest that plagioclase with composition close to albite ($\text{NaAlSi}_3\text{O}_8$) shows complicated transient behaviors of plastic deformation which possibly control the shear localization and the nucleation of fractures in the crust. In this study, we examined a method to fabricate aggregate of albite to examine such properties experimentally in future.

Albite powders for glaze were pulverized using an automatic pulverizer (HERZOG HSM-250A at AIST Tsukuba Central 7) and fine-grained fractions were separated by decantation. The fine-grained powders were hot pressed by a multi-purpose high temperature furnace (Fuji Dempa High Multi 10000 at AIST Chubu). To determine the condition for fabrication, several fractions of particle size from a few hundred nm to 1 micrometer were prepared. Experiments were carried out at temperatures of 1000-1150°C and pressures of 40-100 MPa. For comparison, we have also carried out a sintering at the atmospheric pressure after formation.

Fabrication of dense albite aggregate is difficult due to the lower diffusion coefficient and melting temperature. The run products were partially melted in the experiments at the temperatures higher than 1100°C. The run products were porous and were not completely sintered in the experiments using powders with particle size of 1 micrometer. Even in the experiments using powders using a few hundred nm, it takes about a hundred hours to fabricate dense aggregate under the pressure of 40 MPa and the temperature of 1100°C, although the materials were partially melted. We succeeded to fabricate dense aggregate without melt phase in the experiment using powders with particle size of a few hundred nm under the pressure of 100 MPa and the temperature of 1080 °C for 36 hours.

Above mentioned results indicate that using fine particle size less than a few hundred nm, temperature of around 1080°C and the pressure above 100 MPa are essential for dense fabrication. There is a possibility that microstructures of aggregate controls the complicated transient behaviors expected for albite. We further explore the method to fabricate the aggregates with various microstructures.

Keywords: albite feldspar, hot pressing, fabrication, sintering