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Sintering experiments on fine-grained polycrystalline orthoclase

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K-feldspar is one of the major mineral components of granitic rocks and a wide variety of metamorphic rocks. Its deformational behavior is important for establishing the overall rheology of continental crust. The creep strength is influenced by various factors such as mineral species, grain size and pores. Therefore control of these factors in polycrystalline minerals is essential for rheological experiments. In order to make dense polycrystalline orthoclase, we have carried out sintering experiments.

We prepared submicron mineral powders from a single crystal of orthoclase ($K_{0.83}Na_{0.17}Al_{1.04}Si_{2.96}O_8$). As a result of X-ray fluorescence (XRF) analysis, ZrO2 (<5.65wt.%) which is considered to be contamination from a mill was detected. We formed cylindrical compacts from fine-grained mineral powders by uniaxial dry pressing at room temperature and pressure of 20MPa. Sintering was carried out using a tube furnace at temperature of 970 ℃ for 4 hours, achieving a vacuum condition of $\sim 4.1 \times 10$Pa. We also compared the sintered body with a sample sintered at atmospheric pressure using muffle furnace at the same temperature and the time. Sintered bodies were observed using scanning electron microscope (SEM), and analyzed by XRF and X-ray diffraction (XRD).

As the result of vacuum and atmospheric pressure sintering, we obtained sintered bodies with volume reduction of 52.2% and 44.5%, and porosity of 0.15 and 0.17, respectively. SEM images showed that densification process was advanced by both vacuum and atmospheric pressure sintering. We confirmed that crystal structures (Al/Si order-disorder) were not changed from compacts by XRD patterns.

In this study, we found that dense submicron polycrystalline orthoclase can be made from fine-grained powders by either of vacuum and atmospheric pressure sintering, and confirmed that orthoclase does not cause order-disorder phase transition by a sintering for 4 hours.

Keywords: submicron, orthoclase, sintering