

Mullitization from sillimanite by synchrotron X-ray diffraction experiment and TEM observation

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The polymorphs of Al_2SiO_5 including sillimanite is very important for geologists as indicators of the pressure and the temperature in metamorphic rocks. Moreover, it is well known that sillimanite heated at high temperature transform to mullite $\text{Al}_2[\text{Al}_{2+2x}\text{Si}_{2-2x}]\text{O}_{10-x}$ ($x = 0.17 - 0.59$) [1,2], but the transformation to mullite (which is called as mullitization) from sillimanite has not been well revealed in detail and the mullitization temperature T_c is even not well determined. The main experimental problem is that it is difficult to distinguish sillimanite and mullite by X-ray diffraction (XRD) experiment because each unit cell parameters are very similar. Therefore, we carried out high resolution synchrotron XRD experiment (BL-4B2 in PF, KEK) and transmission electron microscope (TEM, JEOL JEM-2100F) observation for annealed sillimanite, to reveal the behaviour of mullitization.

As the result, the texture like anti-phase boundary (APB) with sub-micro order SiO_2 -rich glass, similar to the texture shown in previous study [3], were observed from the samples heated at various experimental conditions. The high resolution XRD pattern of these samples clearly showed mullite peaks. So, we interpreted that APB-like texture and glass inclusions are the texture of the early stage of mullitization. We made Time-Temperature-Transformation diagram of mullitization by XRD patterns, and estimated the mullitization temperature T_c as about 1013°C

[1] Gyepesova & Durovic (1977) *Silikaty*, **2**, 147-149

[2] Tomba et al. (1999) *Ceramic International*, **25**,

245-252. [3] Holland & Carpenter (1986) *Nature*, **320**, 151-153.