Grain size and cooling rate effect on phase taransition between proto- and clino-enstatite

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[Introduction]
Protoenstatite (PEN, space groupe:*Pbcn*), one of the polymorph of enstatite($MgSiO_3$), is the stable phase at high temperature above 1000°C below 1557°C at atmospheric pressure. It is generally known that protoenstatite is the unquenchable phase. Actually, PEN has never been reported from natural specimens to date. However, Foster (1951), Lee and Heuer(1987), and so on reported PEN was observed at room temperature from experimental generative materials.
Smyth(1974) studied in detail the transformations among polymorphs of enstatite using high temperature single-crystal X-ray techniques. He showed that in rapid quench PEN transformed to clinoenstatite(CEN, *P*21/*c*) and in slow cooling rate PEN transformed to orthoenstatite(OEN, *Pbca*), and concluded that the rapid transformation between PEN and CEN occurs martensitically . On the martensitic transformation, in general, it is known that a parent phase stability is effected of grain size, cooling rates, shear stress and so on. On the PEN-CEN transformation, similar effects reported (e.g Huang et al., 1994), but few quantitative attempts concerning such effects have been made. The purpose in this study is to make clear the condition PEN can retain at room temperature associated with grain size and cooling rates.
[Experiments]
The starting material of experiments was OEN synthesized by the flux method according to Ozima (1982). All experimental specimens are analyzed by the XRD method. (1) Grain size effect: We crushed and assorted synthetic OEN as grain size (1.2, 5.2, 46, 87, 140, 180 um), and heated these samples by the box electric furnace at 1200°C for 20 hours, and after that cooling rate was 5° C/min. (2) Cooling rate effect: Unifying grain size 1.2 um, heated at 1200 °C for 20hr, and after that cooling rate was 6 patterns.(0.1, 1, 3, 5, 10 °C/min, water cooling)
[Results]
(1) Grain size effect: Only CEN peaks existed in the 180 um sample, on the other hand both CEN and PEN peaks existed in the smaller than 140 um. The smaller grain size was, the more PEN retained. It is shown that gran size particularly affects the PEN stability. (2) Cooling rate effect: In the case of a cooling rate was 3 °C/min, most PEN retained. And retained PEN decreased on both the faster and slower cooling than 3 °C/min.
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