Investigation of $Ca_3Ti_1Fe_2O_8$ behavior under high pressure environment

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Abstract

The ordering process of oxygen vacancies in perovskite-structure $Ca_3TiFe_2O_8$ has been studied as a function of composition and temperature (Becerro et al., 2000). We study the effect of pressure on the ordering process of oxygen vacancies and relative properties of perovskite by using Diamond Anvil Cell and X-ray diffraction under pressure up to 26 GPa. No phase transition was observed in this study. The equation of state of $Ca_3TiFe_2O_8$ at high pressure was studied.

Introduction

Perovskite-structured silicate is assumed to be one of the dominate mantle phases in the Earth's interior, the physical states of the Earth are directly affected by this phase. With the composition of perovskite-structured silicate would be formed for the vacancies on the anion at lower mantle conditions. Previous study showed that the oxygen vacancy ordering in $CaTi_{1-X}Fe_XO_{3-X/2}$, solid-solution $CaTiO_3$-$CaFeO_{2.5}$, is a function of composition and temperature (Becerro et al., 2000). In addition, Ross et al.(2002) studied the evolution of the unit-cell parameter of brownmillerite($CaFeO_{2.5}$) under pressure up to 9.46 GPa and observed that the presence of oxygen vacancies not only soften the brownmillerite structure by ~25% but also increase the anisotropy of compression under pressure. In another way, similar study in brownmillerite structure phase $Sr_2Fe_2O_5$ showed a phase transition to tetragonal perovskite-like structure between 11~14GPa. But Ross and his group did not observe the phase transition in brownmillerite up to 9.46GPa, so they assume the phase transition would occur at higher pressure. In order to understand weather this behavior exists in the other composition of $CaTiO_3$-$CaFeO_{2.5}$ series, we studied $Ca_3TiFe_2O_8$ as the experiment material, and hope this study can give a insight to the effect of oxygen vacancies to perovskite phase.

References

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