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Lattice Preferred Orientation in Post-Perovskite type $MgGeO_3$

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Introduction

Since the discovery of post-perovskite type $MgSiO_3$ in 2004[1,2], numerous studies have been made to clarify it properties such as stability filed, equations of state, elastic property, and plastic property. Because, this new phase may explain various strange properties of the layer at the bottom of the lower mantle, a layer called D" layer, which were difficult to explain by any known materials. If the post-perovskite phase forms lattice preferred orientation (LPO) in this layer, strong elastic anisotropy observed in D" layer could be explained and various studies have been made to clarify this possibility. Unfortunately the stability field of the post-perovskite type $MgSiO_3$ is too high to conduct this kind of study and the experiments were made using various analogue materials such as $MgGeO_3$[3] and $CaIrO_3$[4]. Although these two model materials have the same crystal structure, the resulting LPO are quite different and it is difficult at this moment to estimate the behavior of $MgSiO_3$ in the Earth. In the present study we have studied the behavior of post-perovskite type $MgGeO_3$ in detail and concluded that the reported LPO in $MgGeO_3$ [3] is not the deformation texture and cannot be used for the discussion of the D" layer.

Experiments

Experiments were made by squeezing the powdered sample between two diamond anvils and powder X-ray diffraction experiments were made adopting radial diffraction geometry using X-ray transparent gasket [5]. Orthopyroxene (Opx) type $MgGeO_3$ was prepared at atmospheric pressure. The powdered starting material was squeezed to 37 GPa at room temperature and converted into perovskite (Pv) structure by heating it using YAG laser. Then further compression was made to 77 GPa at room temperature and then the post-perovskite phase was formed by heating in a uniaxial stress field. Radial diffraction experiments were made at BL13A of the Photon Factory and observed 2D diffraction patterns were recorded on IP detector. The unrolled X-ray diffraction pattern is shown in Fig.1.

Results and Discussion

Fig. 1 shows that strong LPO was formed in the post-perovskite phase. However, the observed LPO is quite different from that reported in the previous study [3], which was formed directly from orthopyroxene phase. This result strongly suggests that the LPO in $MgGeO_3$ so far reported is not the texture representing the deformation fabric but the texture formed by the topotaxyal relation from the pre phase before the transformation. In order to confirm it, experiments were made to compress post-perovskite phases formed from Opx and from Pv to much higher pressures. The result indicate that the each LPO formed just after the formation remained unchanged even when the pressure is increased to more than 45 GPa after the formation. This is because the sample chamber is too thin to deform during compression. Further careful studies are required to clarify the possible LPO of post-perovskite in the Earth.

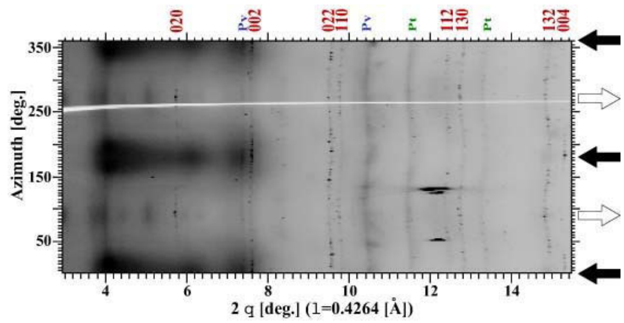

Fig. 1. Unrolled X-ray diffraction profile of the radial diffraction of post-perovskite type $MgGeO_3$ at 77 GPa. Strong lattice preferred orientation different from the one reported before (ref.3) is observed.

References

[1] M. Murakami et al., Science **304**, 855-858 (2004)
[2] A.R. Oganov and S. Ono, Nature **430**, 445-448 (2004)
[3] S. Merkel et al., Science **311**, 644-646 (2006)
[4] D. Yamazaki,et al.,Earth Planet. Sci. Lett. **252**, 372-378 (2006)
[5] S. Merkel & T. Yagi, Rev. Sci. Instrum. **76**, 046109 (2005)

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