Discovery of two hexagonal phases in (Fe,Al)OOH under the P-T conditions of the deep lower mantle

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Deep water can cause a series of complex seismological phenomena by changing the density and thermal stability of lower mantle components. δ-H solid solution phase ($AlOOH-MgSiO_2(OH)$) is stable at lower mantle conditions[1],because the crystallographic frameworks of the phase H is similar to that of the δ-AlOOH phase, with very strong hydrogen bonds[2,3]. δ-AlOOH and ε-FeOOH can also form solid solution[4] (δ-ε solution). It is reasonable to infer that δ-ε solid solution may have similar thermal stability as that of H-δ solution, considering their similar crystal structure[5]. In our experiments, we synthesized the δ-ε solution at 79GPa and 1600K in a laser-heated diamond anvil cell. As the temperature increases to 2100k, the orthorhombic δ-ε solution transformed into a hexagonal-structured phase. By combining powder X-ray diffraction techniques with multigrain indexation[6], we determined its hexagonal lattice with a=b=10.019Å and c=2.614Å. At 79GPa and 2400K, the hexagonal phase transforms into another hexagonal phase, with the lattice parameters of a=b=2.733Å and c=9.343Å. The discovery of these two new phases may provide new insights into the deep-water storage.

References

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