2009年度 第18回

地質学セミナー

日時：2月 3日（水）
17時〜
場所：総合研究棟B棟 110 教室

In situ high-pressure single-crystal X-ray diffraction study of chromite ($FeCr_2O_4$)

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The present study deals with crystal structure investigations of chromite $FeCr_2O_4$ using in-situ single crystal monochromatic X-ray diffraction technique. Spinel, which is one of the common accessory minerals in the Earth's crust and mantle over a wide range of pressure and temperature, forms a variety of polymorphs. The spinel to post-spinel structural transitions are highly important for under-standing the Earth's deep interior (Yamanaka et al. Am. Min. 93, 1874. 2008). We have already reported the transformations of cubic chromite-spinel structureto orthorhombic $CaFe_2O_4$-type structure at 12.5 GPa and then to orthorhombic $CaTi_2O_4$-type structures using laser-heated diamond anvil cell experiments (Chen et al. PNAS, 100, 14651, 2003). Furthermore, we reported that the cubic chromite-spinel transforms to orthorhombic CaAl2O4-type structure at 29 GPa under ambient temperature (Shu et al. Mat. Res. Soc. Symp. Proc. 987, 179, 2007). In this study, we performed the high-pressure X-ray diffraction analysis in more detail using the two-dimensional imaging plate detector systems by which we can measure large volumes of reciprocal space in a quantitative and rapid way. A total of 26 X-ray diffraction measurements from 1.9 to 39.3 GPa were conducted using diamond anvil cell at BL13BM-D in the Advanced Photon Source at Argonne Natio-nal Laboratory. We indexed the X-ray diffraction patterns recorded on the imagingplate carefully. They can be assigned only as a cubic cell with face-centered lattice up to 27.1 GPa. The a unit cell parameter of chromite decreases linearly from 8.228(2) to 8.003(7) Å with increasing pressure. At higher pressure, many diffraction spots which are not considered to belong to cubic symmetry were observed. The diffraction spots can be indexed to a mixture of the cubic spinel and a phase whose reciprocal lattice is described by tetragonal system. Moreover, the high-pressure phase can be determined to the body-centered lattice that is transformed from the face-centered cubic lattice directly. The diffraction spots corresponding to the cubic cell completely disappear at 29.2 GPa. The tetragonal phase continues up to 32.5 GPa and reverts to the cubic phase immediately by decreasing the pressure without any hysteresis. The experimental result of pressure-induced phase transition of $FeCr_2O_4$ chromite spinel is clearly different from that of chromite polymorph "xieite" in meteorite (Chen et al. PNAS, 100, 14651, 2003). （座長；山岡伸司）

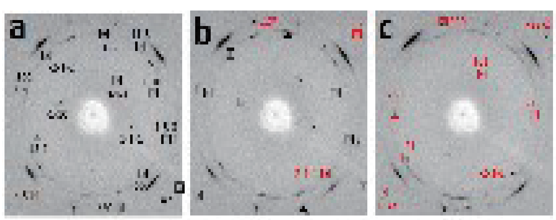

Figure. The single-crystal X-ray diffraction patterns of chromite at (a) 21.1 GPa, (b) 28.1 GPa, and (c) 32.5 GPa. The black squares show X-ray reflections indexed on cubic cell, whereas the red ones indexed on tetragonal cell.

次回のお知らせ

日時：2月10日（水）　１７時〜

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