Thermal Equation of State of Magnesiowustite ($(Mg_{0.6}Fe_{0.4})O$ *	X17B1

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It is generally regarded that magnesiowustite, (Mg,Fe)O, is one of the major phases that constitute the Earths lower mantle. Accurate determination of its equation of state (EOS) is of fundamental importance for developing compositional and mineralogical models of the Earths interior. In this regard, the EOS of $(Fe_{0.4}Mg_{0.6})O$, determined by Fei et al. (1992), has been widely used in literature. This work, however, was limited to a relatively low temperature range (300-750 K) and therefore unable to provide reliable constraint on thermal expansion at ambient pressure.

In this work, the isothermal volume measurements of $(Mg_{0.6}Fe_{0.4})O$ were carried out up to 10 GPa at the temperatures 300, 473, 673, 873, 1073, and 1273 K, using energy-dispersive synchrotron X-ray diffraction. The extended temperature range allows reliable determination of the temperature dependence of the bulk modulus, $(\partial K/\partial T)_P$. In particular, each isothermal volume dataset was collected at pressures as low as 1 GPa, which yielded good constraint on the thermal expansion at ambient pressure which was previously not known. From these data, the EOS parameters were derived from various approaches based on the Birch-Murnaghan EOS and on the relevant thermodynamic relations. The results are consistent; with $(\partial K/\partial P)_T$ fixed at 4, we obtained K_0 = 158(3) GPa, $(\partial K/\partial T)_P$ = -0.029 GPa K^{-1}, $\alpha = 3.32(21)\times10^{-5} + 1.29(34)\times10^{-8}T$. The K_0 and $(\partial K/\partial T)_P$ values are in agreement with those of Fei et al. (1992) and are similar to previously determined values for MgO (Fei, 1999 and references therein). In addition, the ambient thermal expansion of $(Mg_{0.6}Fe_{0.4})O$ is similar to the data of Suzuki (1975). These results suggest that the effect of Fe substitution in magnesiowustite is negligibly small, at least within the composition range x = 0 - 0.4 in $(Mg_{1-x}Fe_x)O$.

References: Fei, et al. (1992) Phys. Chem. Minerals 18: 416-422

Fei, (1999) Am. Mineral. 84: 272-276

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