

Magnetic phase diagram of (Mg,Fe)O: reinvestigation

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(Mg,Fe)O shows complex magnetic behavior due to the presence of non-magnetic magnesium ion. For example, $(\text{Mg}_{0.23}\text{Fe}_{0.77})_{0.92}\text{O}$ shows Neel transition at 128 K and spin-glass like phenomena below 76 K at ambient pressure [Abbas and Hicks, 1990]. Although we reported a magnetic phase diagram and suggested that the magnetic structure would be differ between iron-rich side and magnesium-rich side [Fujii et al. 2011], the magnetic property of (Mg,Fe)O at ambient pressure is still unclear. In this study, we reexamined the compositional dependence of magnetic ordering of (Mg,Fe)O at ambient pressure. We used Superconducting Quantum Interference Device (SQUID) magnetometer (MPMS-7 or MPMS-XL, Quantum design Inc.) to measure the temperature dependence of magnetic susceptibility by cooling sample in zero field (ZFC) and in a field (FC). The magnetic field dependent of susceptibility and the temperature dependence of AC magnetic susceptibility were newly measured. In the iron-rich (Mg,Fe)O, the ZFC curve show a peak-like cusp at relatively high temperature and a kink at low temperature. An irreversibility was observed between the ZFC curve and FC curve below the kink temperature. These behaviors are the same as those of $(\text{Mg}_{0.23}\text{Fe}_{0.77})_{0.92}\text{O}$ observed in the previous study [Abbas and Hicks, 1990]. Therefore, the kink and the cusp would indicate a spin-glass transition and Neel transition, respectively. In the case of the magnesium-rich (Mg,Fe)O, the ZFC curve show no kink and an irreversibility below the cusp temperature. Therefore, it would show no Neel transition but spin-glass transition. We also observed a superparamagnetic like phenomena in all sample. These interpretations are supported by the magnetic field dependence of susceptibility and the AC magnetic susceptibility measurement. Therefore, the magnetic ordering of magnesium-rich (Mg,Fe)O is distinctly different from iron-rich (Mg,Fe)O at ambient pressure.

Keywords: (Mg,Fe)O, magnetic ordering