A new system for measurements of AC magnetic susceptibility and Curie temperature with application to natural magnetic minerals

Akihiko Fujiwara[1]; Takashi Nishioka[2]; # Kazuto Kodama[3]

[1] Kochi Core Center, Kochi Univ.; [2] Material Sci, Kochi Univ; [3] CAMCore, Kochi Univ

We report a new system for measurements of alternating-current (AC) magnetic susceptibility and Curie temperature (Tc) of natural magnetic minerals. The system measures AC magnetic susceptibility, or, exactly, complex magnetic susceptibility, through measurements of mutual inductance of a secondary coil winding around a small cement tube, in which a sample of a few milligrams is set. A primary coil is wound just outside of the secondary coil that is coated by a thin cement layer for insulation. The primary coil applies a weak, c.70 A/m, AC magnetic field with a frequency of 10 kHz. A heater coil is wound non-magnetically around the innermost tube and coated, along with a Pt-Rh thermocouple, by heat-resistive cement for thermal insulation. The inducted voltage of the secondary coil is measured with a lock-in amplifier. The dimension of the system is c.6 mm x 17 mm, designed to be small enough to measure Tc in high vacuum, and further at high pressure that is our ultimate goal. We first of all carried out the system calibration by means of Tc measurements of a synthetic sample (Nickel with Tc: 358 degrees) and a natural magnetite (Tc: 580 degrees). The output voltage from the secondary coil is in the order of 10 microvolt, which is large enough to recognize rapid changes in susceptibility corresponding to Tc. One of the advantages of our system is the capability of measurements of AC susceptibility that would change with the frequency of applied field. We also report results of a series of experiments for the frequency dependence of some natural and synthetic magnetite samples.