METHOD FOR CALIBRATION SAMPLE MANUFACTURING FOR SPACE INSTRUMENTATION AND REGOLITH CHARACTERIZATION

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The measurement of the magnetic field by means of magnetometers is the most straightforward method for the characterization of magnetic bodies. The magnetic field generated by a body (in the absence of electrical currents) comprises a remnant and an induced contribution. This last one is due to the magnetization of the body under the effect of a magnetic field. Often, it is important to distinguish between these two contributions. During magnetic surveys, it helps to improve the interpretation of the magnetic carriers that yield the magnetic signature. In general, it is useful to estimate the magnetization changes that a body is expected to have when it is immersed in a magnetic field.

Magnetization's induced contribution is characterized by magnetic susceptibility χ (or relative permeability $\mu_r = 1 + \chi$), measured using susceptometres. Magnetic susceptibility consists of real and imaginary components, representing magnetization response and energy losses, respectively. Most available susceptometres are bulky and laboratory-dependent, and portable versions capable of measuring complex susceptibility are scarce, with limited frequency ranges and calibration standards. This work presents a procedure for manufacturing calibration samples with known magnetic susceptibility for complex susceptibility measurements within the 10 kHz to 18 GHz frequency range. These calibration samples ensure accuracy in magnetic sensors and facilitate standardization. We focus on the fabrication and characterization of samples for a portable susceptometre developed for planetary exploration. This prototype, MS-2, is derived from the NEWTON Project (EU grant 730041) and operates at frequencies up to 300 kHz, measuring both real and imaginary susceptibility. Calibration samples for MS-2 must be parallelepiped-shaped, slightly exceeding its 30 x 10 mm sensing area, while samples for a coaxial transmission line method using the EpsiMu kit require cylindrical shapes with internal and external diameters of 3mm and 7mm, respectively.

Fabrication of these samples took place at INTA, Madrid, using magnetite (Fe_3O_4) powder in a low-susceptibility matrix derived from clay powder. The powder mixture of magnetite and clay ensures better homogeneity than other methods. Homogeneity is validated statistically through measurements on bulk sample fragments using a Vibrating Sample Magnetometer. The finalized samples are tested using MS-2 and the EpsiMu kit. This work lays the foundation for improved magnetic sensor calibration and the development of standardized reference materials.

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