

Development of A Highly Sensitive AC/DC
Magnetometer utilizing High- T_c SQUID for
Characterization of Magnetic Mixture Materials

2015, September

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ABSTRACT

Magnetometers have become considerably important nowadays in many fields owing to promising potentials of non-invasive magnetic technique. A magnetometer that possesses high sensitivity, compact and low-running cost is rather desired so that it is versatile compared to conventional magnetometers and applicable in many areas. This thesis reports a development of an AC/DC magnetometer using a high- T_c SQUID (high critical temperature superconducting quantum interference devices) with a flux transformer. The critical feature of the system is the use of a high- T_c SQUID and a normal conductive detection coil, which enables the realization of a compact, highly sensitive and low-running-cost system. Optimizations and improvements performed during this work to increase the performance of the developed system are presented. Implementation of a feedback system of dual excitation coil enabled a wide range of excitation magnetic field to be achieved with high resolution. Optimizations on the shape of detection coil and sample increased the sensitivity in DC susceptibility measurement. The proposed harmonic detection technique for DC susceptibility measurement was effective in improving the signal-to-noise ratio. A compensation coil technique was implemented during fabrication of detection coil for AC susceptibility measurement to archive effective reduction in interference signal from excitation magnetic field and compact integration of AC/DC detection coil. This thesis culminates with two demonstrations of the developed system in a non-destructive evaluation of moisture content in mortar and a characterization of magnetic moment distribution in low-concentration solutions of magnetic nanoparticles for bio-medical applications. The separation of magnetic properties in mixture materials was successfully achieved with high sensitivity in both applications. The developed system can be expected as a powerful instrument for explorations of magnetic properties and non-destructive tests in future.

ACHIEVEMENTS

AWARDS

1. The Best Student Paper-Second Place in Electronics, Applied Superconductivity Conference and IEEE Council of Superconductivity, 2014.8.15.
2. 博士前期課程の研究科長賞, 岡山大学自然科学研究科 電子情報システム工学専攻 電気電子機能開発講座, 2013.3.25.
3. 第33回(2012年秋季)応用物理学会講演奨励賞, 「サンプル振動型磁化率計の高感度計測法」第73秋季 回応用物理学会学術講演会, 愛媛, 2012.9.11-14.

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