DEVELOPMENT OF AN APPARATUS FOR LOW-TEMPERATURE MAGNETIC SUSCEPTIBILITY MEASUREMENTS

S. Hamigah, P. Peratheepan and F.C. Ragel

Department of Physics, Faculty of Science, Eastern University, Vantharumoolai, Batticaloa (EP), Sri Lanka
Corresponding author: hamiselva@gmail.com

Mutual inductance technique employed in Hartshorn bridge is one of the most convenient and reliable methods for magnetic susceptibility measurements. In Hartshorn bridge, a two phase lock-in-amplifier, a measuring coil, helipot, a mutual inductance box and *ac* power supply are connected in series, and a cathode ray oscilloscope is connected in parallel to the lock-in-amplifier in order to measure the output signal. When a sample is inserted into the sample space of a secondary in the coil, it induces a voltage which can be detected by the lock-in-amplifier as an off-balanced voltage as a measure of susceptibility of the sample. We have constructed a two phase lock-in-amplifier, two measuring coils, and a low temperature *dc* electrical resistivity probe. The two phase lock-in amplifier was design and constructed with six interconnected circuits: two input signals with in-phase and out-of phase, two demodulators and two low-pass filters. The demodulators and the low-pass filter circuits are used to multiply the input signals and to remove the *ac* component of the *dc* output, respectively. The measuring coil was constructed with two secondaries of each 1,200 (3,000) turns in opposite direction over a primary coil of 3,000 (10,000) turns on a cylindrical Teflon tube. The stainless steel resistivity probe has a sample chamber and a coaxial Manganese solenoid. The solenoid delivers controlled heat to the sample which is mounted on a thin flat copper platform with a four leads resistant thermometer. The induced magnetic field in the measuring coil with primary 3,000 (10,000) turns is verified to be linear up to ~4 mA (~10 mA) upon increasing and decreasing current. For the purpose of performing low-temperature magnetic susceptibility measurements, we modified the resistivity probe by exchanging the sample platform by a measuring coil that is connected in a Hartshorn bridge by four leads to the primary and secondaries of the measuring coil that would be at variable temperatures down to 77 K.

Keywords: Lock-in-amplifier, Magnetic susceptibility, Mutual inductance, Measuring coil, Resistivity probe