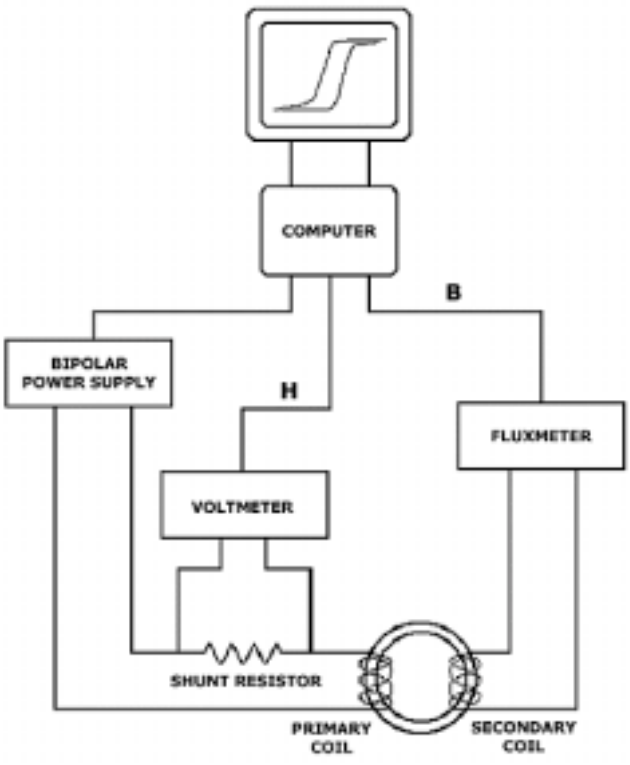
How a Hysteresisgraph Measures the BH-Curve of Soft Magnetic Materials

Determining the magnetic properties of soft magnetic materials can pose challenges. These challenges are due mainly to the fact that these materials are very response to magnetic fields, and therefore, the applied magnetic field of these materials must be strictly controlled to get any useful information. Fortunately, an instrument called a hysteresisgraph or BH-Meter exists which allows for the magnetic properties of soft magnetic materials to be measured. This application note describes the operation of this instrument.

Basic Operation of Hysteresisgraph to Measure Soft Magnetic Materials

A hysteresisgraph has two major functions. It produces current to produce a magnetic field, and measures voltage over time to measure magnetic induction. By determining the induction response of the test sample to the applied current, the magnetic properties of the material is determined.

It is instructive to provide a specific example, which is shown on the following page. Most soft magnetic materials are measured using ring geometry. (The advantage of a ring geometry will be discussed in subsequent application note.) Two coils of wire are wound around the sample. A current from a bi-polar power supply is passed through the primary coil to generate a magnetic field in the ring. The applied magnetic field is proportional to the current. As the sample magnetic induction changes in response to the applied magnetic field, a voltage is induced in the secondary windings. This induced voltage is integrated over time with a circuit often called a fluxmeter, as it is used in many applications to measure magnetic flux. The integrated voltage is proportional to the magnetic induction of the test sample. The current in the primary coil is determined by measuring the voltage across a resistor. Commercial hysteresisgraphs use a computer to control the applied field and measure both B and H simultaneously.



Measurement of an Initial BH-Curve

An initial BH-curve consists is generated by slowly increasing the applied magnetic field from zero to some value on a demagnetized sample. Initial BH-curves of a soft magnetic material are often used to model the performance of soft magnetic materials in an electro-mechanical device.

As these are important curves for magnetic design, these curves are measured using a hysteresisgraph. For accurate initial curves, the sample must be demagnetized prior to the measurement. This demagnetization can be performed either externally, or in many cases, the sample can be demagnetized by the hysteresisgraph. Note that it is very important for the sample to be demagnetized below 2-3% of its maximum induction value. Residual magnetization can greatly distort the response of a soft magnetic material near zero field.

AC BH-Curve Measurements

In many applications, soft magnetic materials are subjected to cyclical magnetic fields. The response of a soft magnetic material can be very complicated in this case, and is determined by both material parameters such a sample permeability and resistivity and material geometry. It can be exceedingly difficult to make accurate predictions of material performance through computer models. Therefore, the best way to determine the performance of these materials is to measure the BH-curve under cyclical applied magnetic fields.

This can be performed using a hysteresisgraph. The bi-polar power is driven at the test frequency, and the fluxmeter can measure the varying magnetic induction of the material. The resulting BH-curves are called AC BH-curves, and yield important information in regards to the material such as AC permeability and core loss. For these types of measurements, it is important that the hysteresisgraph components have the appropriate frequency response to measure the AC BH-curve properly.

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