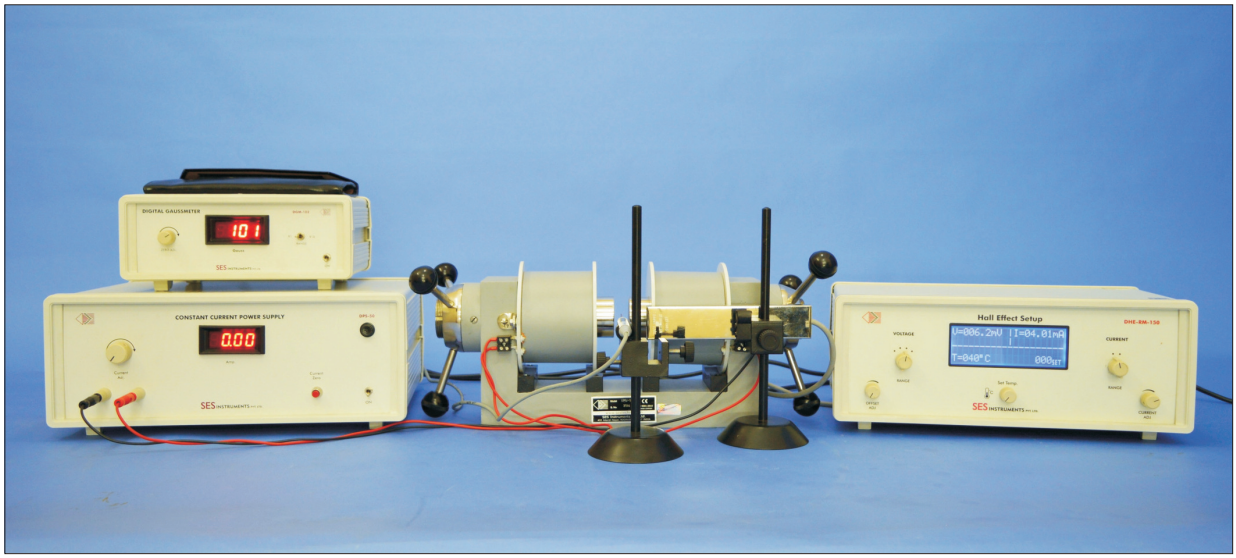
Hall Effect Experiment

HEX-RM-150

SES Instruments Pvt Ltd.

Hall Effect Experiment (Research Model)



Introduction

When a current-carrying conductor is placed in a magnetic field perpendicular to the current direction, a voltage develops transverse to the cuurent. This voltage was first observed in 1879 by Edwin Hall and the effect is called Hall Effect.

The Hall effect has since led to a deeper understanding of the details of the conduction process. It can yield the density of the charge carriers as well as their sign. The hall voltage for p-carriers has opposite sign from that for n-carriers. Therefore if a semiconductor with p-type doping is gradually heated up, more and more electrons from its valence band will go to conduction band. As a result hall voltage would fall rapidly with temperature and even become zero or change sign. At the point of zero Hall Coefficient, it is possible to determine the ratio of mobilities $b = m_e/m_h$. The Hall coefficient inversion is a characteristic of only p-type semiconductors.

Theory

As you are aware, a static magnetic field has no effect on charges unless they are in motion. When the charges flow, a magnetic field directed perpendicular to the direction of flow produces a mutually perpendicular force on the charges. When this happens, electrons and holes will be separated by opposite forces. They will in turn produce an electric field (E_h) which depends on the cross product of the magnetic intensity, H, and the current density, J.

$E_h = RJ \times H$ where R is called the Hall Coefficient

Now, let us consider a bar of semiconductor, having dimension, x, y and z. Let J be directed along X and H along Z then E_h will be along Y.

Then we could write

$$R = \frac{V_h/y}{\quad} \qquad \frac{V_h.z}{\quad}$$

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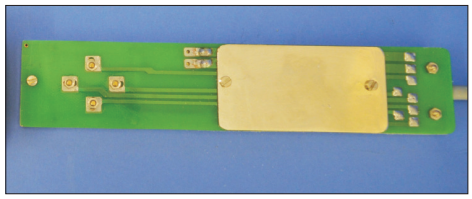
Hall Effect experiment consists of the following

The set-up consists of the following.

1. Hall Probe (Ge: p-type), HPP-RM-33



Ge single crystal with four spring type pressure contacts is mounted on a glass-epoxy strip. Leads are provided for connections with the current source and Hall voltage measuring devices.

Oven

It is a small oven which could be easily mounted over the crystal or removed if required.

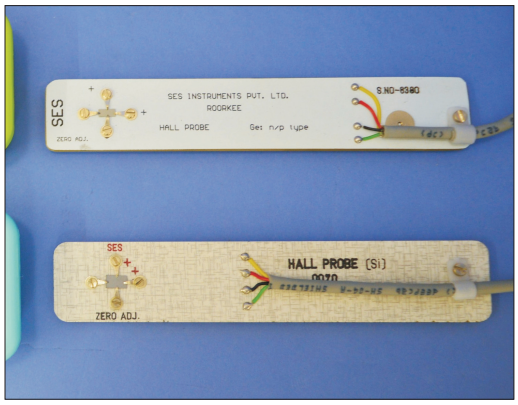
Temperature Sensor

Cromel-Alumel thermocouple with its junction at a distance of 1mm from the crystal.

2. Hall Probe (without sample), HPP-RM-33NS

Same Hall Probe at HPP-33, except that it comes without sample, to enable the user to mount their own sample.

3. Hall Probe (Ge Crystal), HPN-RM



Ge single crystal with four spring-type pressure contacts is mounted on a sunmica-decorated bakelite strip. Four leads are provided for connections with measuring devices.

Technical details

- Material : Ge single crystal n-type
- Resistivity : 8-10Ω.cm
- Contacts : Spring type (solid silver)
- Zero- Field potential : <1mV (adjustable)
- Hall Voltage : 25-35mV/10mA/KG

4. Hall Probe (Si Crystal), HPSi-RM

Si single crystal with four spring-type pressure contacts is mounted on a sunmica-decorated bakelite strip. Four leads are provided for connections with measuring devices.

Technical details

- Material : Si single crystal n-type
- Resistivity : 14-15Ω.cm
- Contacts : Spring type (solid silver)
- Zero- Field potential : <1mV (adjustable)
- Hall Voltage : 25-35mV/10mA/KG

This probe is very similar to HPN-RM.

5.Hall Probe (without sample), HP10-RM

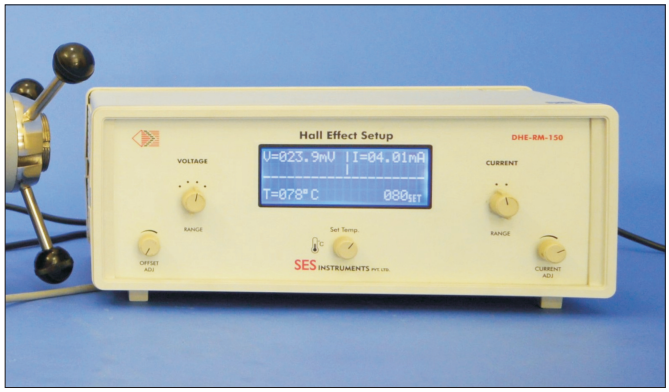
Same Hall Probe at HPN-RM, except that it comes without sample, to enable the user to mount their own sample of 10x10mm size.

6.Hall Probe (without sample), HP05-RM

Same Hall Probe at HPN-RM, except that it comes without sample, to enable the user to mount their own sample of 5x5mm size.

7.Hall Effect Set, DHE-RM-150

(a) Digital Millivoltmeter



Specifications

Range : 1mV, 10mV, 100mV, 1V & 10V with 100% over-ranging.

Resolution : 1μV

Accuracy : ±0.2% ±1 digit

Stability : Within ±1 digit

Input Impedance : >1000MΩ (10MΩ on 10V range)

Display : 3½ digit, 7 segment LED with autopolarity and decimal indication

(b) Constant Current Power Supply

Specifications

Range : 0-20mA, 0-200mA

Resolution : 10μA

Accuracy : ±0.25% of reading ±1 digit

Display : 3½ digit, 7 segment LED with autopolarity and decimal indication

5. Electromagnet, EMU-75T *(Refer datasheet for specifications)*

6. Constant Current Power Supply, DPS-175-C2 *(Refer datasheet for specifications)*

7. Digital Gaussmeter, DGM-202-C1 *(Refer datasheet for specifications)*

Optional Attachments

This model of Hall Effect Experiment may be connected to a computer for data logging purposes. Necessary hardware and software can be ordered with the system.

The setup is complete in all respect