INDIAN INSTITUTE OF INFORMATION TECHNOLOGY SONEPAT भारतीय सूचना प्रौद्योगिकी संस्थान, सोनीपत

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INDIAN INSTITUTE OF INFORMATION TECHNOLOGY SONEPAT

Applied Science Lab

Experiment-1

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EXPERIMENT-1

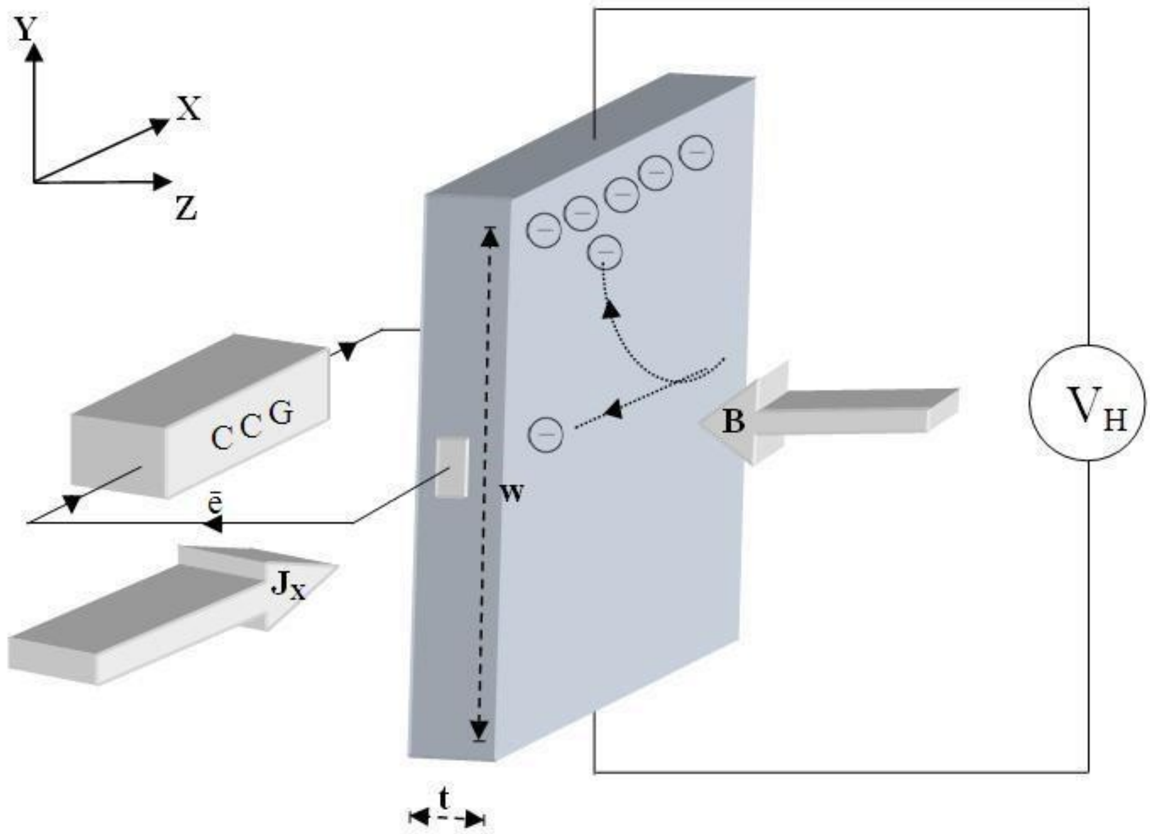
Aim:

(a) To calibrate an electromagnet.
(b) To study the dependence of Hall voltage on magnetic field and current through the sample.

Theory:

If a current carrying conductor placed in a perpendicular magnetic field, a potential difference will generate in the conductor which is perpendicular to both magnetic field and current. This phenomenon is call Hall Effect. In solid state physics, Hall effect is an important tool to characterize the materials especially semiconductors. It

Fig. 1: Schematic representation of Hall Effect in a conductor.

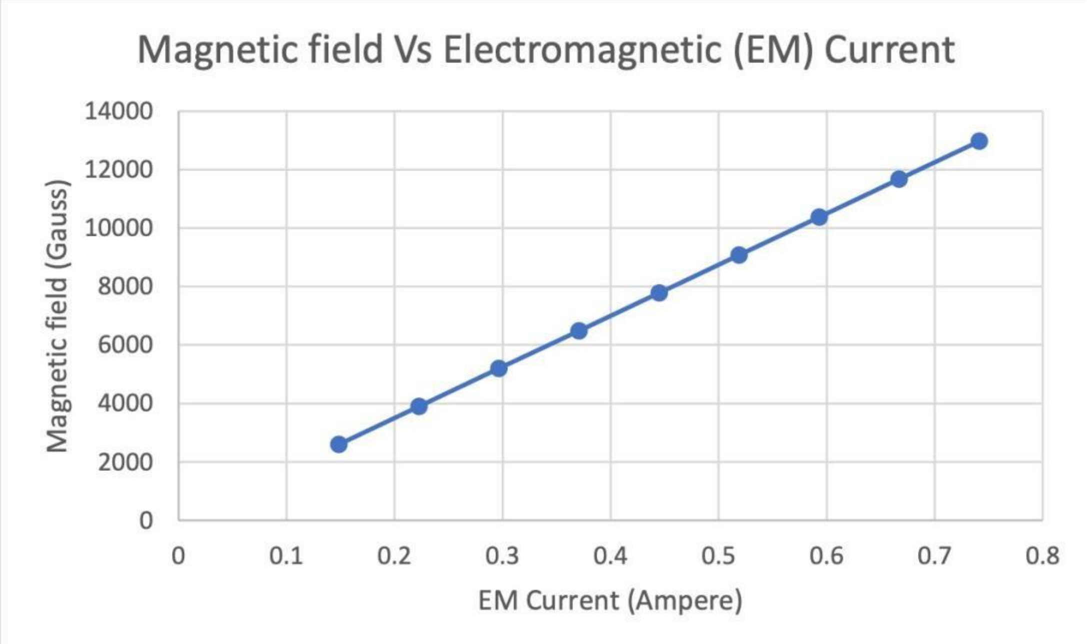


directly determines both the sign and density of charge carriers in a given sample.

Fig. 1: Schematic representation of Hall Effect in a conductor.

Observation Table (a):

Calibration of Electromagnet



Electromagnetic Current (I) A	Magnetic Field (H) Gauss
1	0.1482
1.5	0.2223
2	0.2964
2.5	0.3706
3	0.4447

Electromagnetic Current (I) A	Magnetic Field (H) Gauss
3.5	0.5188
4	0.5929
4.5	0.6670
5	0.7411

Observation Table (b)

(b $Vh = Ih \times Rh \times H$

Vh = Hall Voltage

Ih = Hall Current

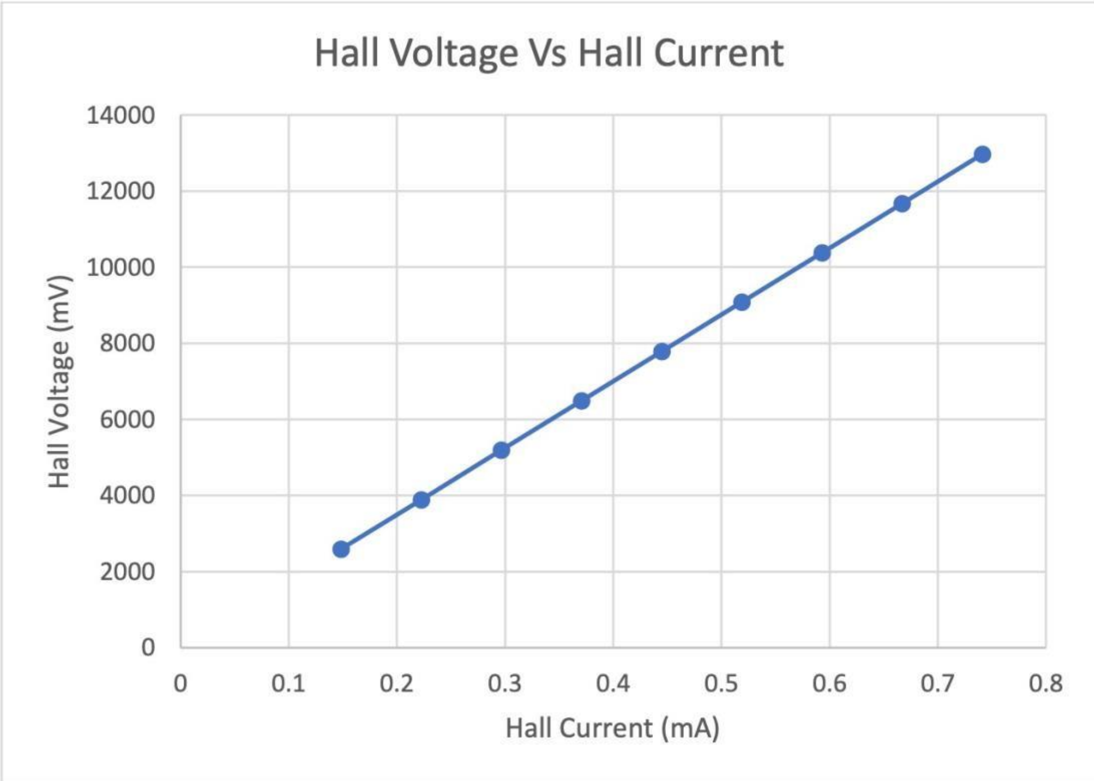
Rh = Hall Coefficient

H = Applied Magnetic Field on Electromagnetic t

= Sample Thickness

(i) Applied Magnetic field, H is constant but Hall Current (I_H) iv varying Sample: Gold t = 0.0001 m, H = 0.2223 Gauss (corresponding to coil current of 1.5 mA)

Hall current (I) mA	Hall Voltage (Vh) mV
1	1556.362
1.5	2334.544
2	3112.725
2.5	3890.906
3	4669.087
3.5	5447.269
4	6225.450
4.5	7003.631
5	7781.812



Calculation: Slope,

m = 1556.363

m=Rh*H/t

0.7001 /

Or Rh=mt/c= 1556.363 × 0.0001 = m3 C (experimental

value) H 0.2223

Given value (as calculated by simulator) = 0.7 m^3/C

Carrier Concentration, n = 1 = 8.916441613 × 10^{18} m^{-3}

(experimental

Rh × e

value)
Given value (as calculated by simulator) = 8.92857 X 10^{18} m^{-3}

(ii) Applied Magnetic field, H is varying but Hall Current (I_H) is constant Sample: Gold t = 0.0001 m, Hall Current I_H = 2.5 mA

Electromagnetic current(I) A	Magnetic Field(H) Gauss	Hall Voltage (Vh)
1	0.1482	2593.938
1.5	0.2223	3890.906
2	0.2964	5187.875
2.5	0.3706	6484.844
3	0.4447	7781.812
3.5	0.5188	9078.781
4	0.5929	10375.750
4.5	0.6670	11672.719
5	0.7411	12969.687

, 0.7001

Hall Coefficient Rh = m × t= 17502.94197 × 0.0001 = m^3/

C

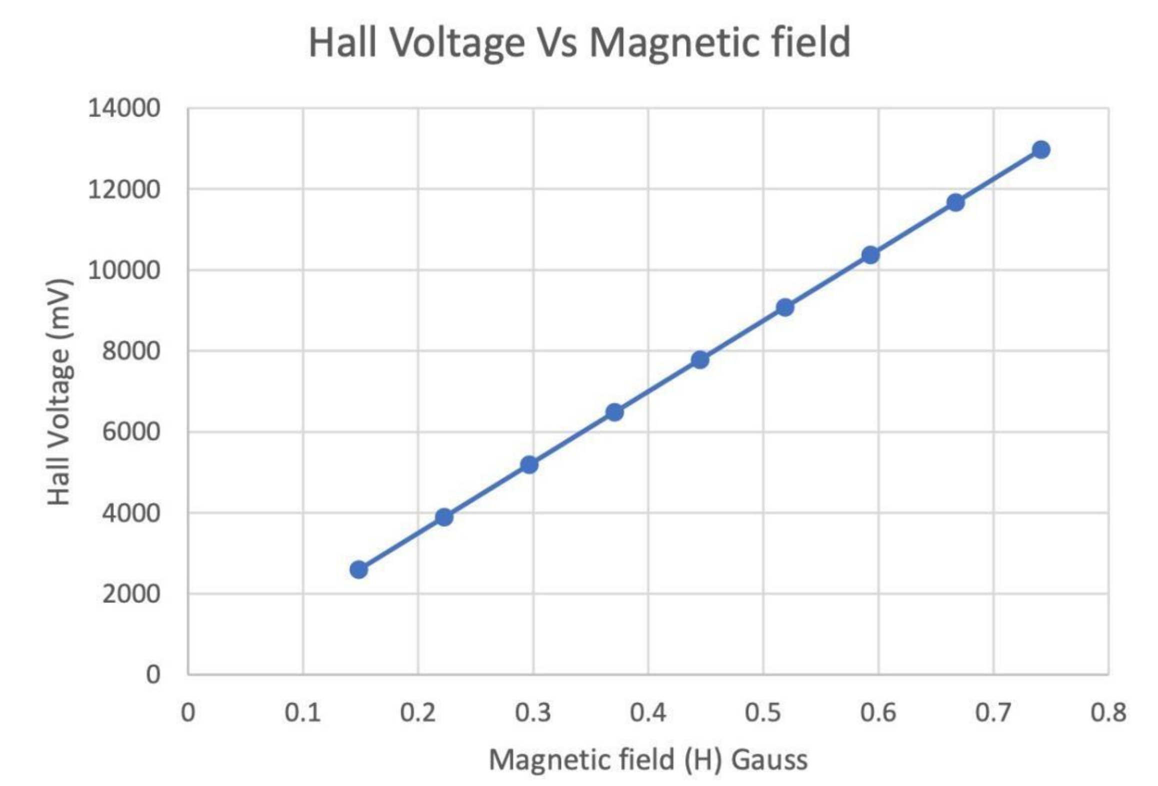
Ih 2.5

H

(experimental value)
Given value (as calculated by simulator) = 0.7 m^3/C

Carrier Concentration, n = ^{1} = 8.916441613 × 10^{18} m^{-3}

(experimental Rh × e value)



Given value (as calculated by simulator) = 8.92857 X

10^{18} m^{-3}

Results & Discussion:

1. The Hall coefficient of Gold is 0.7 m^3/C which is exactly equal to standard value.

2. The of carrier concentration is approximately equal to $8.92857 \times 10^{18} m^{-3}$. There is some error because the value of electronic charge is taken $1.60217662 \times 10^{19}$ by me and the simulator must have taken a far less precise value.
3. In this experiment we learned about the Hall effect, its properties and calibration of electromagnet.

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