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2K20/A6/56
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EXPERIMENT - 1

AIM:

To Study Hall Effect and to determine, Hall voltage V_H , Hall Coefficient R_H and hence find the density of charge carriers in a semiconductor at room temperature by Hall effect measurement.

Observations:

Material used: Germanium (Ge)

1) Magnetic field for different current through solenoid

Trial Number	Current through solenoid (A)	Magnetic field generated (Tesla)
1.	1	0.1482
2.	1.5	0.2223
3.	2	0.2964

2) Calculation of Hall Voltage, Hall Coefficient and Carrier concentration

Case I: For Magnetic Field = 0.1482 T

Trial Number	Magnetic Field (Tesla)	Thickness (t) (mm)	Hall Current (mA)	Hall Voltage (mV)	R_H
1.	0.1482	0.1	1	28.765	0.0194
2.	0.1482	0.1	1.5	43.133	0.0194
3.	0.1482	0.1	2	57.511	0.0194
4.	0.1482	0.1	2.5	71.889	0.0194
5.	0.1482	0.1	3	86.267	0.0194
6.	0.1482	0.1	3.5	100.645	0.0194

Case II: For Magnetic Field = 0.2223 T

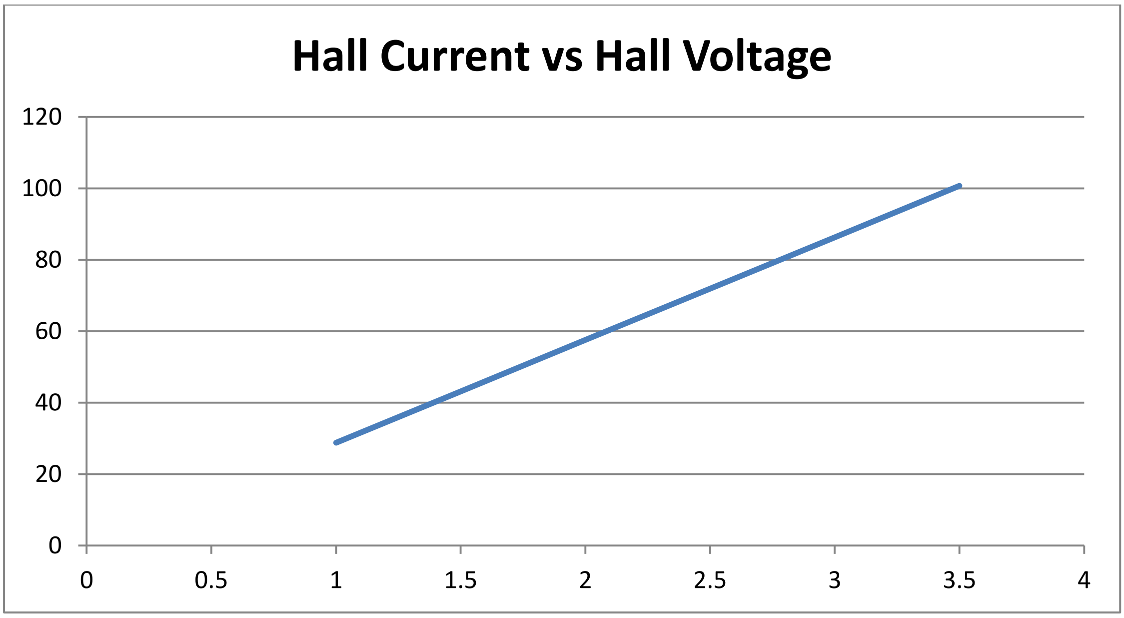
Trial Number	Magnetic Field (Tesla)	Thickness (t) (mm)	Hall Current (mA)	Hall Voltage (mV)	R_H
1.	0.2223	0.1	1	43.133	0.0194
2.	0.2223	0.1	1.5	64.700	0.0194
3.	0.2223	0.1	2	86.267	0.0194
4.	0.2223	0.1	2.5	107.834	0.0194
5.	0.2223	0.1	3	129.400	0.0194
6.	0.2223	0.1	3.5	150.967	0.0194

Case III: For Magnetic Field = 0.2964 T

Trial Number	Magnetic Field (Tesla)	Thickness (t) (mm)	Hall Current (mA)	Hall Voltage (mV)	R_H
1.	0.2964	0.1	1	57.511	0.0194
2.	0.2964	0.1	1.5	86.267	0.0194
3.	0.2964	0.1	2	115.023	0.0194
4.	0.2964	0.1	2.5	143.778	0.0194
5.	0.2964	0.1	3	172.534	0.0194
6.	0.2964	0.1	3.5	201.290	0.0194

Calculations:

Case I: For Magnetic Field = 0.1482 T



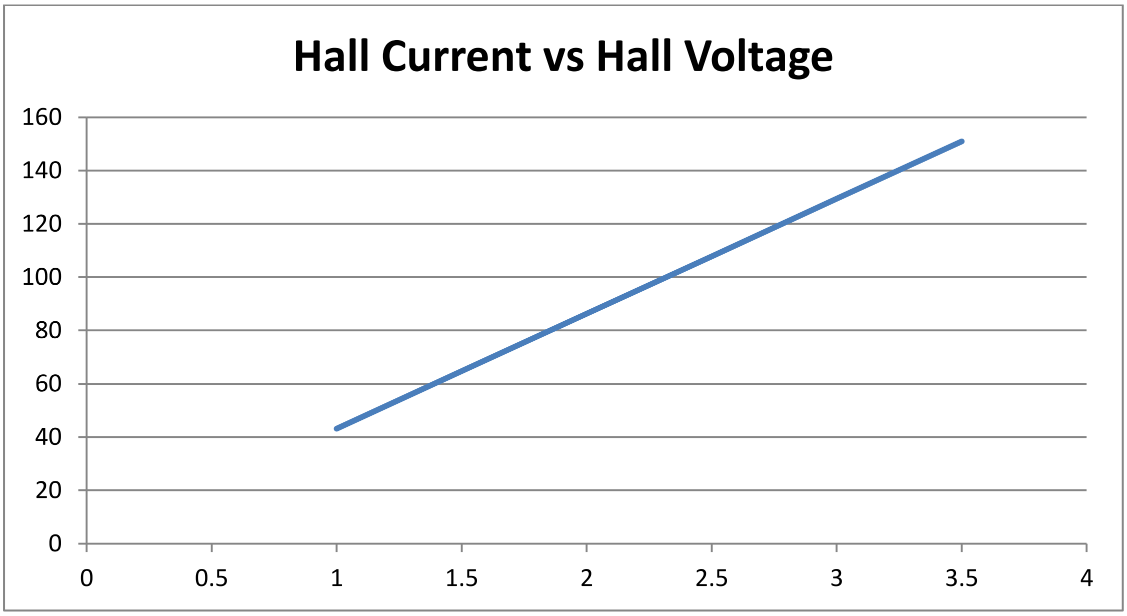
Hall Coefficient, $R_H = \frac{V_H t}{i_H B} = \frac{(slope)t}{B}$

Slope of the straight line, $slope = \frac{71.889-43.133}{2.5-1.5} = 28.756\ ohm$

Hall Coefficient, $R_H = \frac{(28.756)(0.1\ X\ 10^{-3})}{0.1482} = 0.0194\ m^3/C$

Density of charge carriers, $n = \frac{1}{eR_H} = \frac{1}{1.602\ X\ 10^{-19}\ X\ 0.0194} = 3.22165\ X\ 10^{20} m^{-3}$

Case II: For Magnetic Field = 0.2223 T



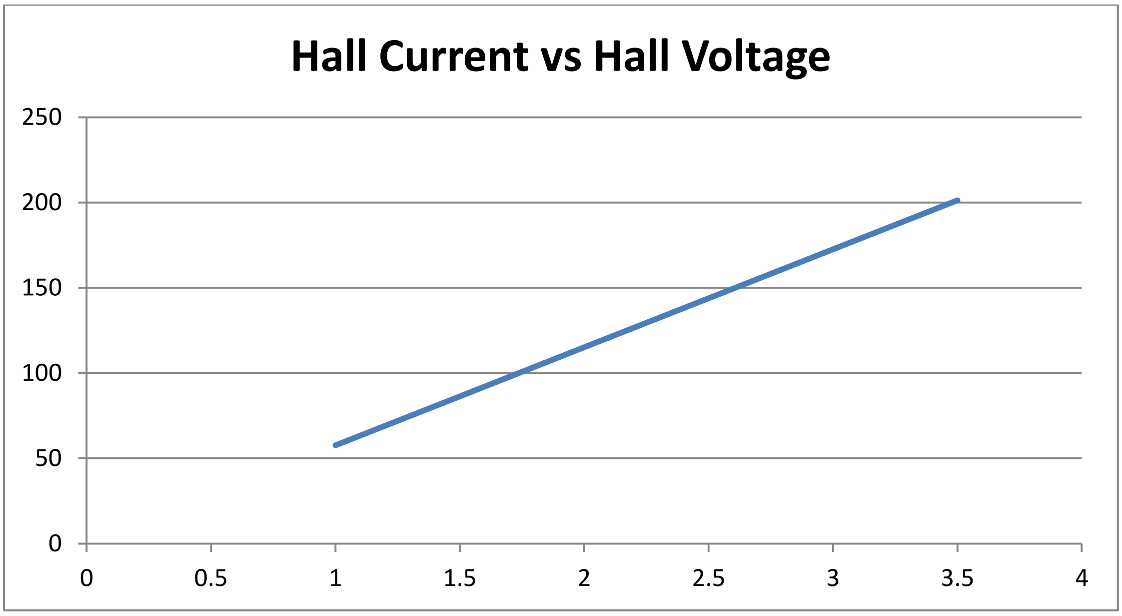
Hall Coefficient, $R_H = \frac{V_H t}{i_H B} = \frac{(slope)t}{B}$

Slope of the straight line, $slope = \frac{107.834-64.7}{2.5-1.5} = 43.134\ ohm$

Hall Coefficient, $R_H = \frac{(43.134)(0.1\ X\ 10^{-3})}{0.2223} = 0.0194\ m^3/C$

Density of charge carriers, $n = \frac{1}{eR_H} = \frac{1}{1.602\ X\ 10^{-19}\ X\ 0.0194} = 3.22165\ X\ 10^{20} m^{-3}$

Case III: For Magnetic Field = 0.2964 T



Hall Coefficient, $R_H = \frac{V_H t}{i_H B} = \frac{(slope)t}{B}$

Slope of the straight line, $slope = \frac{143.778-86.267}{2.5-1.5} = 57.511\ ohm$

Hall Coefficient, $R_H = \frac{(57.511)(0.1\ X\ 10^{-3})}{0.2964} = 0.0194\ m^3/C$

Density of charge carriers, $n = \frac{1}{eR_H} = \frac{1}{1.602\ X\ 10^{-19}\ X\ 0.0194} = 3.22165\ X\ 10^{20} m^{-3}$

Results:

At room temperature,
Hall Coefficient of the material, $R_H = 0.0194\ m^3/C$
Density of charge carriers or, Carrier Concentration, $n = 3.22165\ X\ 10^{20} m^{-3}$