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Title of the experiment :- Hall effect

Objective :

To determine the Hall cofficient of the given semiconductor crystal (Germanium)

Equipment List :-

- Electromagnet and power supply.
- Semiconductor crystal
- Current Source and Ammeter
- Voltmeter
- Connecting wires

Formula :-

The Hall-coefficient is given by,

$$R_H = \frac{V_H \cdot t}{I\,B} \quad (\text{v.m/A.tesla})$$

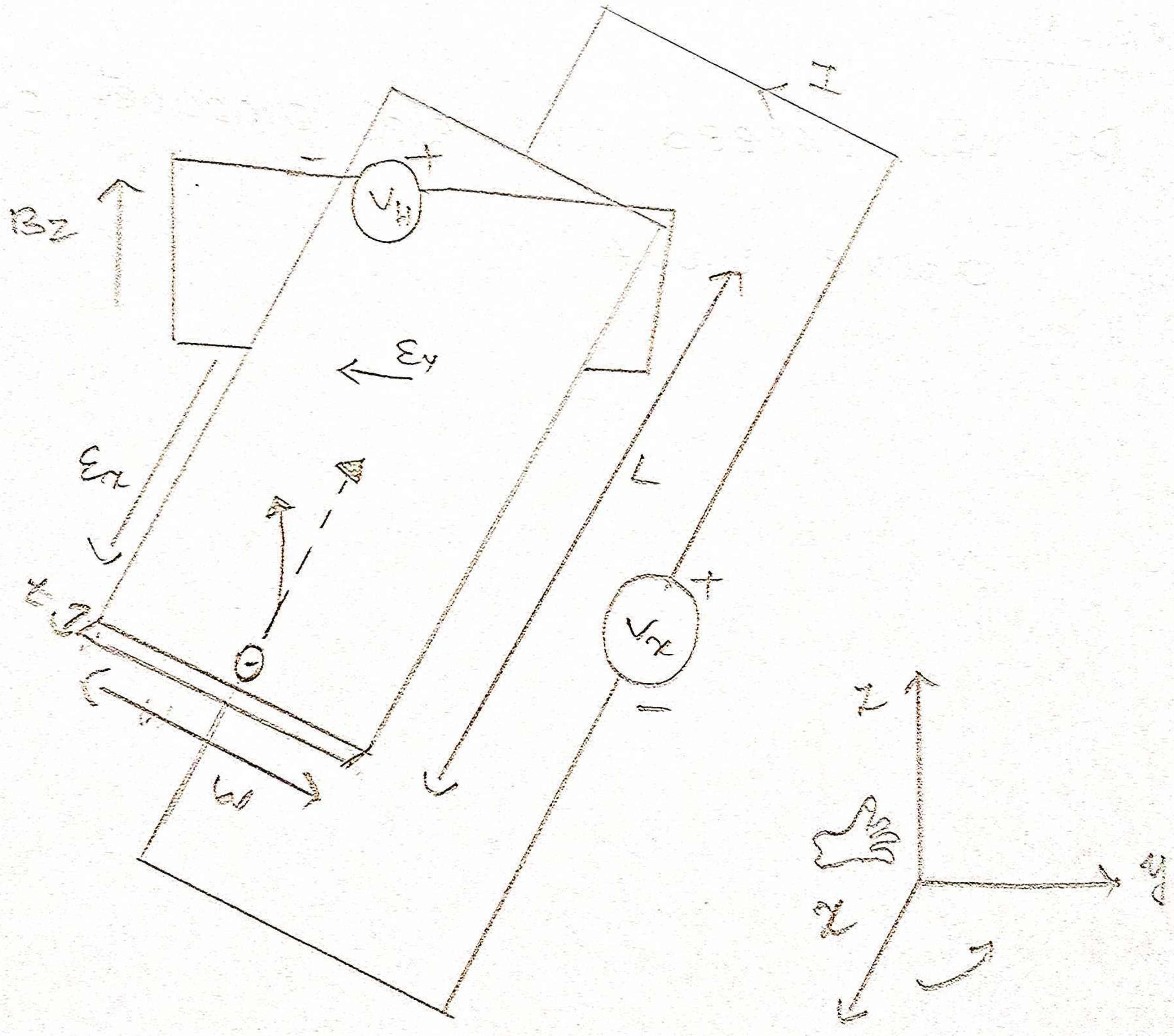
Here V_H : Hall voltage developed

I : Current passing through the sample

B : Applied magnetic field

t : Thickness of the semiconductor crystal

$V_H = V_{HB} - V_{HO}$ (V_{HB} - in presence of magnetic field,



Schematics of Hall effect set up for electrons

V_{HO} - zero field potential)

Calculations :-

Table 1:- $t = 0.5mm$, $V_{HO} = 191.3\ mV = 0.191V$, $I = 5mA$

Magnetizing current (A)	Hall voltage		Magnetic field (B) Tesla	R_H
	V_{HB}	$V_H = V_{HB} - V_{HO}$		
1.00	128.1	$V_H = 128.1 - 0.191 = 127.909$	80×10^{-4}	1598
1.75	89.7	$V_H = 89.7 - 0.191 = 89.509$	144×10^{-4}	621
2.50	47.4	$V_H = 47.4 - 0.191 = 47.209$	211×10^{-4}	223
3.25	21.8	$V_H = 21.8 - 0.191 = 21.609$	260×10^{-4}	830
4.00	2.8	$V_H = 2.8 - 0.191 = 2.609$	298×10^{-4}	8.72 ~~87.55 $\times 10^2$~~

Mean $R_H = 656.144$

$\rightarrow$ ① $R_H = \frac{V_H \cdot t}{IB} = \frac{127.909 \times 0.5 \times \cancel{10^{-3}}}{5 \times \cancel{10^{-3}} \times 80 \times 10^{-4}} = \frac{63.9545 \times 10^4}{5 \times 80}$

$= 0.1598 \times 10^4$

$= 1598$.

② $R_H = \frac{V_H \cdot t}{IB} = \frac{89.509 \times 0.5 \times \cancel{10^{-3}}}{5 \times \cancel{10^{-3}} \times 144 \times 10^{-4}} = \frac{44.7545 \times 10^4}{5 \times 144}$

$= 0.0621 \times 10^4$

③ $R_H = \frac{V_H \cdot t}{IB} = \frac{47.209 \times 0.5 \times \cancel{10^{-3}}}{5 \times \cancel{10^{-3}} \times 211 \times 10^{-4}} = \frac{23.6045 \times 10^4}{1055}$

$= 0.0223 \times 10^4$

$= 223$

(4) $R_H = \frac{21.609 \times 0.5 \times \cancel{10^{-3}}}{5 \times \cancel{10^{-3}} \times 260 \times 10^{-4}} = \frac{10.8045 \times 10^{4}}{1300}$

$R_H = \frac{V_H \cdot t}{IB}$

$= 0.00830 \times 10^{4}$

$= 830$

(5) $R_H = \frac{V_H \cdot t}{IB} = \frac{2.609 \times 0.5 \times \cancel{10^{-3}}}{5 \times \cancel{10^{-3}} \times 298 \times 10^{-4}} = \frac{1.3045 \times 10^{4}}{1490}$

$= \frac{1.3}{149} \times 10^{3}$ $= 8.~~7550 \times 10^{4}~~$

$= 0.0087 \times 10^{3} = 8.72$ $=$ ~~875.5×10^{2}~~

Table 2: Applied magnetic field $B = 80 \times 10^{-4}$ Tesla

Input current to the sample (mA)	Hall voltage		R_H
	V_{HB}	$V_H = V_{HB} - V_{H0}$	
5	135.0	$V_H = 135 - 0.191 = 134.809$	1685
4	91.0	$V_H = 91 - 0.191 = 90.809$	1135
3	65.0	$V_H = 65 - 0.191 = 64.809$	810
2	29.0	$V_H = 29 - 0.191 = 28.809$	36

Mean $R_H = 916.5$

→ ① $R_H = \frac{V_H \cdot t}{I \cdot B} = \frac{134.809 \times 0.5 \times \cancel{10^{-3}}}{5 \times \cancel{10^{-3}} \times 80 \times 10^{-4}} = \frac{67.4045}{400 \times 10^{-4}}$

$= 0.1685 \times 10^4$

$= 1685$

② $R_H = \frac{V_H \cdot t}{IB} = \frac{90.809 \times 0.5 \times \cancel{10^{-3}}}{5 \times \cancel{10^{-3}} \times 80 \times 10^{-4}} = \frac{45.4045}{400 \times 10^{-4}}$

$= 0.1135 \times 10^4$

$= 1135.$

③ $R_H = \frac{V_H \cdot t}{IB} = \frac{64.809 \times 0.5 \times \cancel{10^{-3}}}{5 \times \cancel{10^{-3}} \times 80 \times 10^{-4}} = \frac{32.4045}{400 \times 10^{-4}}$

$= 0.0810 \times 10^4$

$= 810.$

(4) $R_H = \frac{V_H \cdot t}{IB} = \frac{28.809 \times 0.5 \times \cancel{10^{-3}}}{5 \times \cancel{10^{-3}} \times 80 \times 10^{-4}} = \frac{14.4045}{400 \times 10^{-4}}$

$= 0.0360 \times 10^{4}$

$= 36.$

Precautions:-

Do not exceed the electromagnet current above 4.00 A.

Result:-

1. The Hall coefficient of the given semiconductor crystal was found to be 656.144

2. The Hall coefficient of the given semiconductor crystal was found to be 916.5