Lab mst worksheet

* Quantum physic

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Branch - cse-IoT
subject - Quantum and semiconductor physics.

* Aim of experiment -

To determine the resistivity of semicond-uctor by four probe method.

* Apparatus -

sr. no.	equipment	Range	quantity
1.	power supply	220 V	1
2.	oven	0 to 200 °c	1
3.	n-type crystal	NA	1
4.	mill-Ammeter & milli voltage.	0-20mA 0-250mA	1

* observation -

1. material used for the experiment → silicon
2. Distance between two probes → 0.2 cm
3. thickness used for the experiment → 0.05cm
4. current (I) used for the experiment → 45mA

Observation table -

Sr. No.	Temp.	Temp (K)	voltage	Resistivity (ρ) (Ω-cm)
1.	25.5°C	298	5.663 mV	26.8396
2.	30°C	303	5.393 mV	25.5598
3.	35°C	308	5.117 mV	24.2497
4.	40°C	313	4.863 mV	23.0456
5.	45°C	318	4.629 mV	21.9363
6.	50°C	323	4.413 mV	20.9123

* formula -

$$\rho = \frac{\rho_0}{f\left(\frac{w}{s}\right)} \qquad \rho_0 = \frac{V}{I} \times 2\pi s$$

$f \rightarrow$ correction factor.

$f = 5.89$ form standard table.

* calculations -

calculation for resitivity -

1)

$V = 5.663$ mV

$I = 45$ mA

$s = 0.2$

$\rho_0 = ?$

$$\rho = \frac{\rho_0}{f(\omega/s)} \qquad \rho_0 = \frac{V}{I} \times 2\pi s$$

$$\rho_0 = \frac{5.663}{45} \times 2 \times 3.14 \times 0.2$$

$$\rho_0 = 0.1580 \text{ mV.m}$$

$$\rho = \frac{0.1580}{5.89} = 0.02683 \times 10^3$$

$$\boxed{\rho = 26.893 \text{ ohm-cm}}$$

2)

$V = 5.393$, $I = 45\text{mA}$, $s = 0.2\text{cm}$

$$\rho_0 = \frac{5.393 \times 2 \times 3.14 \times 0.2}{45} = 0.15024 \times 10^3$$

$$\rho = \frac{0.15024}{5.89} = 0.02555 \times 10^3$$

$$\boxed{\rho = 25.555}$$

3)

$V = 5.117\text{mV}$, $I = 45\text{mA}$, $s = 0.2$

$$\rho_0 = \frac{5.117 \times 3.14 \times 2 \times 0.2}{5.89} = 0.142821 \times 10^3$$

$$\rho = \frac{0.142821 \times 103}{5.89} = 0.02424 \times 103$$

$$\boxed{\rho = 24.2495 \text{ ohm-cm}}$$

4) $V = 4.863$ mV, $I = 45$ mA $S = 0.2$ cm

$$\rho_0 = \frac{4.683 \times 2 \times 3.14 \times 0.2}{45}$$

$$\rho_0 = 0.1357 \times 103$$

$$\rho = \frac{0.1357}{5.89} = 0.02304 \times 103$$

$$\boxed{\rho = 23.044 \text{ ohm-cm}}$$

5) $V = 4.629$ mV, $I = 45$ mA, $S = 0.2$ cm

$$\rho_0 = \frac{4.629 \times 2 \times 3.14 \times 0.2}{45}$$

$$\rho_0 = 0.129200 \times 103$$

$$\rho = \frac{0.129200}{5.89} = 0.021935 \times 103$$

$$\boxed{\rho = 21.9355 \text{ ohm-cm}}$$

6) $V = 4.413$, $I = 45\,mA$, $S = 0.2\,cm$

$$\rho_0 = \frac{4.413 \times 2 \times 3.14 \times 0.2}{45}$$

$$\rho_0 = 0.12317 \times 103$$

$$\rho = \frac{0.12317}{5.89} = 0.020912 \times 10^3$$

$$\boxed{\rho = 20.912 \text{ ohm-cm}}$$

* **persentage error** -

NO

* **Graph** -

NO

* **source error** -

1) the resistivity of material should be uniform in the area of measument.

2) the surface on which the probes rest should be flat with no surface leakage.

* Result and discussion -

Resistivity of semiconductor = 21.96 ohm-cm
at 45°C

The resisitivity -decrease exponentially with the increase in tempreture that is as low tempreture resistivity is more and at high tempreture the resitivity is less.

* * *

Thank you!