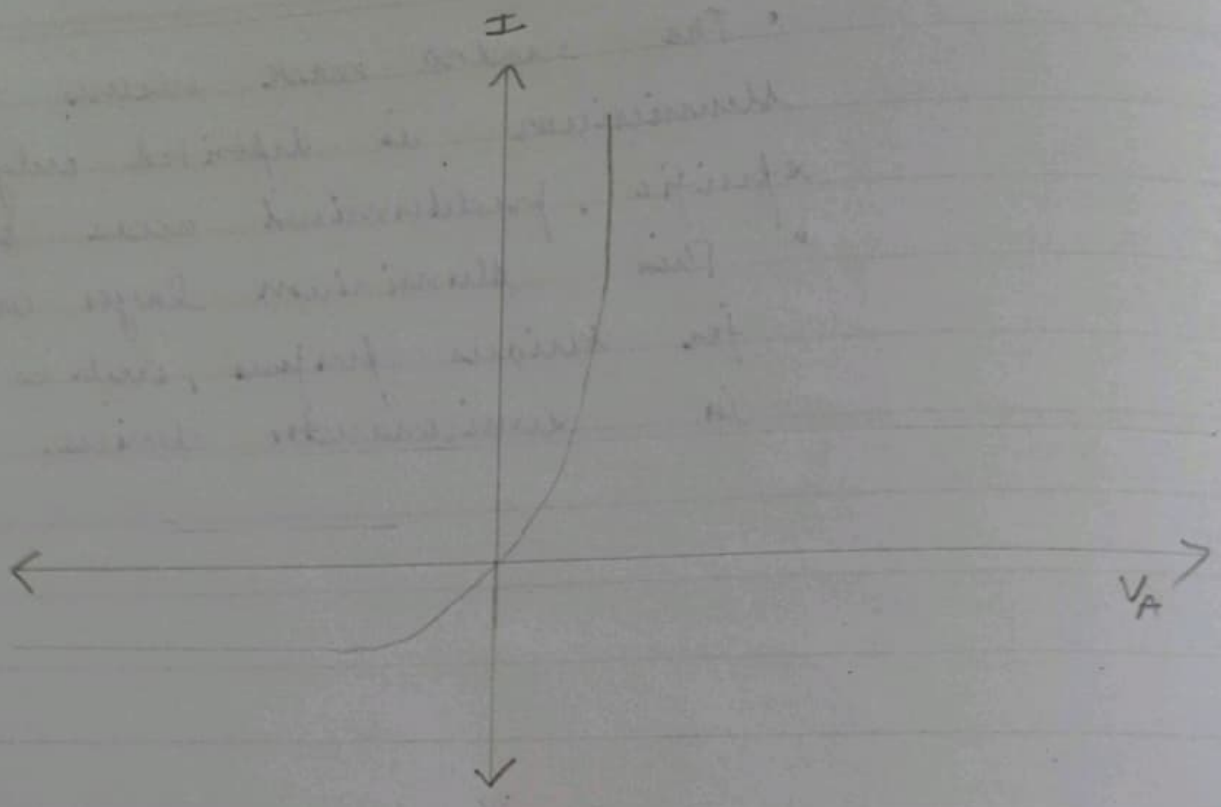
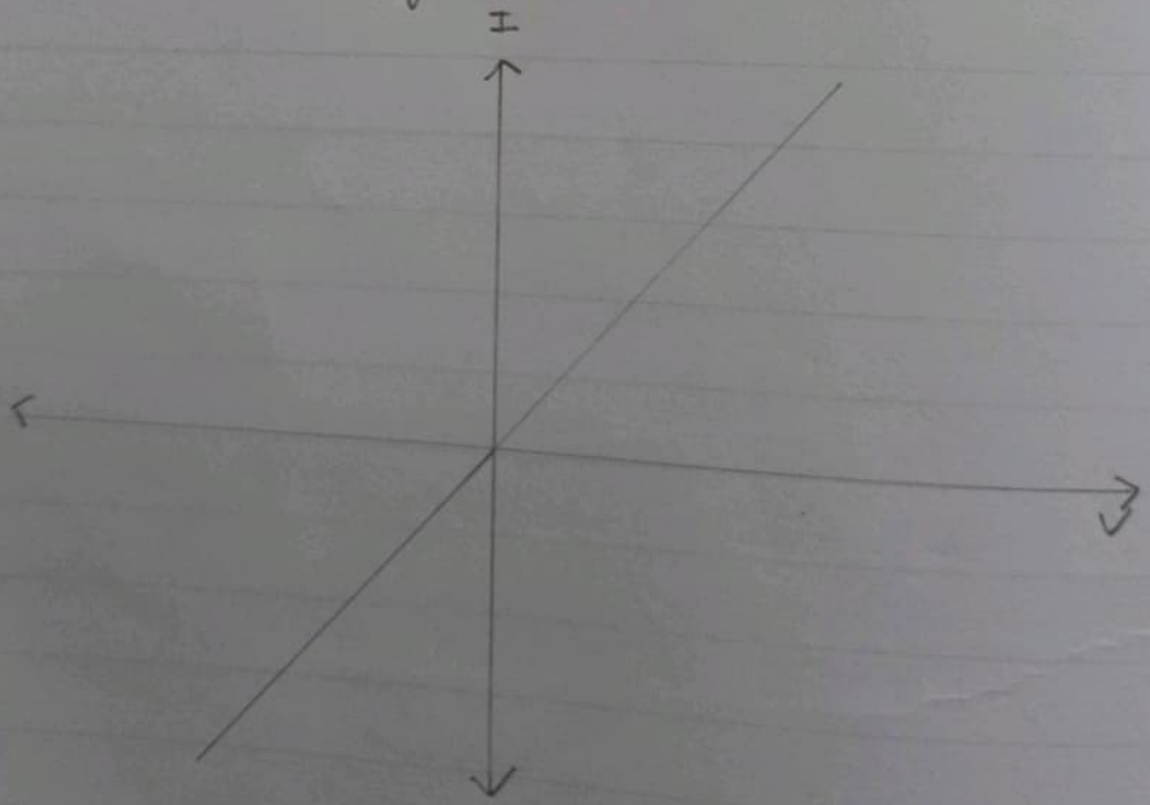


IV characteristics of Schottky defects

Fig. (1)



IV characteristic of ohmic Contact

Fig. ( )

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EXPERIMENT - 5

Aim :- IV characteristic of Metal contact.

Materials Required

1. n type Silicon coated with Aluminium
2. p type Silicon coated with Aluminium
3. Keithley 4 probe characterization system
4. Probing needles or tips (four in total)
5. Connecting cables and appropriate connectors
6. Sample holder / stage
7. Computer with data aquisition software

Theory :-

In general, the current flowing through Schottky contact can be defined with the applied voltage, which is very similar to those of p-n junction diode. The IV expression is :

$$I = I_0 e^{(qV_A/KT - 1)}$$ where I_0 is saturated current

Under forward bias ($V_A > 0$), when forward bias exceeds than few KT/q volts, the current will be dominated by the exponential term. For a reverse bias ($V_A < 0$), when the reverse bias greater than a few KT/q volts, the exponential term will be neglected, which results a small saturate current $I = -I_0$. The IV characteristics

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	n- type Semiconductor	p- type Semiconductor
$\phi_M > \phi_S$	Rectifying	Ohmic
$\phi_M < \phi_S$	Ohmic	Rectifying

ϕ for p-type semiconductor is 4.55 - 4.76 eV

ϕ for n type semiconductor is 4.63 - 4.66 eV

ϕ of Aluminium is 4.2 eV

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is shown in figure 1.

Ohmic Contact

Not all MS contact can perform as the rectifying Schottky Diode, since there is no potential barrier formed. Under this situation, when all current can be conducted in both directions of MS contact, the contact is defined as Ohmic contact. An ideal Ohmic contact is low resistance, and non-rectifying junction with no potential exists between the metal-semiconductor interface.

Since there is no barrier structure for electron flow from semiconductor to metal, even a very small forward bias voltage ($V_A > 0$) will rise a large forward bias current. When there is an applied reverse bias voltage, a small potential barrier is formed for electron flow from metal to semiconductor. However, the small barrier will eventually vanish when the reverse bias voltage becomes large.

Procedure

1. Sample Preparation

→ Ensure that p-type semiconductor sample with an aluminium-coated surface is clean and free from contaminants.

→ Clean the sample using isopropyl alcohol and to remove any surface residues.

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2. Setup

→ Setup the Keithley 4-probe characterization system according to the manual

3. Probing needle preparation

→ Attach four probing needles to the Keithley system.

→ Check that the needles are securely attached and properly aligned.

4. Sample Mounting

→ Securely mount the prepared semiconductor sample on the sample holder or stage.

→ Position the sample so that the Aluminium-coated surface is accessible for probing.

5. Needle positioning

→ Position the probing needles over the aluminium-coated area of the semiconductor sample.

→ Adjust the spacing and alignment of the needles to ensure proper contact with the sample.

6. Measurements

→ Apply a known voltage to Al-coated p & n type using Keithley system

→ Measure the resulting current flow through the sample

7. Data recording and analysis

→ Record the measurement data, including voltage and current values.

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Conclusion

As the work function of Aluminium is less than that of n or p type semiconductor, as expected the n-type shows ohmic behaviour and IV characteristics were obtained as shown in fig 1, and p type shows rectifying behaviour and the graph obtained were as fig. 2.

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