LAB-7 ENERGY GAP OF SEMICONDUCTOR DIODE

8.1 Introduction

In solid state physics, a band gap, also called an energy gap, is an energy range in a solid where no electronic states can exist. In graphs of the electronic band structure of solids, the band gap generally refers to the energy difference (in electron volts) between the top of the valence band and the bottom of the conduction band in insulators and semiconductors. It is the energy required to promote a valence electron bound to an atom to become a conduction electron, which is free to move within the crystal lattice and serve as a charge carrier to conduct electric current.

8.2 Objective

8.2.1 Educational:

To determine the energy band gap of a semi conducting material, we study the variation of its conductance with temperature. In reverse bias, the current flowing through the PN junction is quite small and internal heating of the junction does not take place. When PN junction is placed in reverse bias the current flows through the junction due to minority charge carriers only. The concentration of these charge carriers depend on band gap Eg.

8.2.2 Experimental:

To determine the energy band gap of a given semiconductor using a diode in reverse bias.

8.3 Prelab Preparation:

8.3.1 Reading:

Temperature dependence of resistivity of a semiconductor. Band Gap in different semiconductors

8.3.2 Written:

Keep the worksheet ready with required write up, Formulae, Tabular columns and theoretical values.

8.4 Equipment needed

1. P-N diode, power supply
2. voltmeter
3. microammeter
4. thermometer and heating arrangement for the diode

8.5 Formula

The Energy gap of Semiconductor diode is given by :

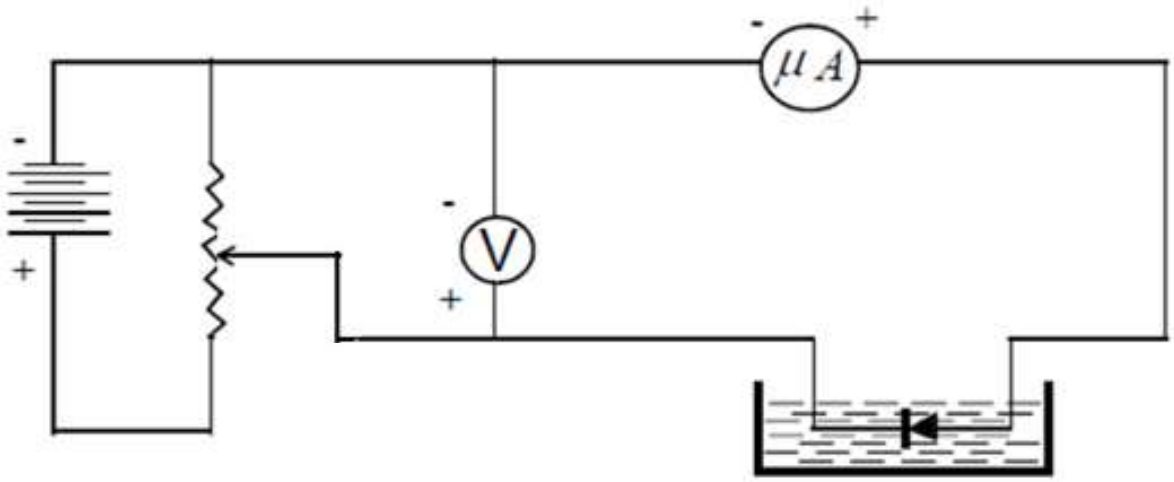
E_g = $Slope * 2.302 * 10^3 * k$ Jouls

Where K = Boltzmann constant = $1.308 * 10^{-23}$

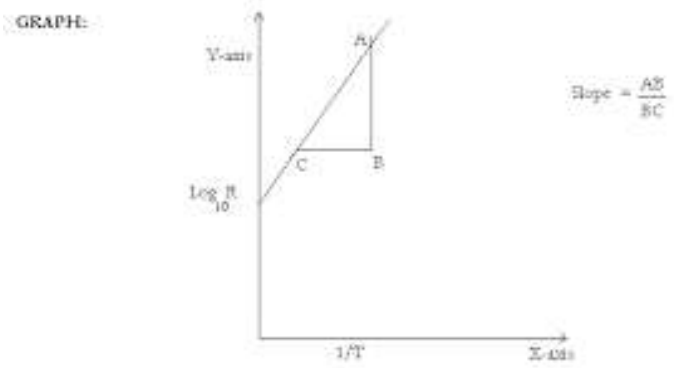
E_g = $Slope * 2.302 * 10^3 * 1.308 * 10^{-23}$ Jouls

E_g = $Slope * 1.983 * 10^{-1}$ eV

8.6 Circuit Diagram



8.7 Model Graph



8.8 Procedure

1. The diode is connected in reverse bias as shown in the circuit diagram.
2. The diode is placed in an oil bath.
3. The temperature of the oil is noted.
4. A constant potentialdifference (say 10 V) is applied and the current Isis noted.
5. The temperature is raised to 80oC and the corresponding current is noted.
6. The experiment is repeated by decreasing temperature in steps of 10oC (upto 40oC).
7. A graph is plotted by taking the numerical values of (log10)R on Y-axis and 103/T on the x-axis.
8. Then we get a straightline graph with positive slope.
9. The slope of the graph is found out.
10. The band gap energy is calculated using formula.

8.9 Observation

S No	Temperature t^OC	Temperature T(K)	$\frac{1}{T} * 10^3$	Reverse bias current (Is)in A	$R = \frac{V}{I}$	$\log_{10} R$
1						
2						
3						
4						
5						

8.10 Results

The energy band gap of a given semiconductor is ..... eV.

8.11 Viva Voce

1. Define energy gap.
2.How p-n junction is formed?
3. What are intrinsic and extrinsic semiconductors.
4. Discuss forward and reverse biasing of diode.
5. Explain depletion layer in pn junction.

8.12 Further Probing Experiments

Q_1: Determine the Energy gap of Silicon semiconductor.
Q_2: Study the functioning of reverse Zener Diode with temperature.