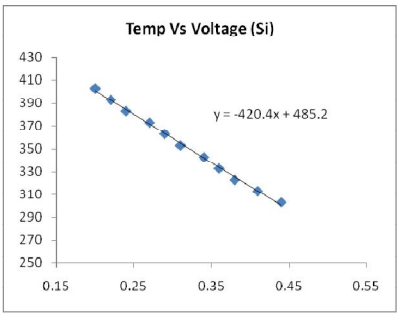
FORBIDDDEN ENERGY GAP KIT ®

OBJECTIVE

MEASUREMENT of Energy Band Gap of Semiconductors like Si, Ge etc using p-n junction diodes and LEDs.

In Forbidden Energy Gap Kit, **the Forward biased voltage of a silicon/germanium diode or LED is studied as a function of temperature**. The results can be used to evaluate Forbidden Energy Gap of Silicon, Germanium and L.E.D. The kit is self contained and needs no additional equipment.

Theory:



The current- voltage characteristic of a *p-n* junction is given by

$$I = I_0[\exp(eV/kT) - 1] \qquad \ldots(1)$$

where I is the current through the diode, Io is the maximum current for a large reverse bias voltage, e is the electron charge, V is the voltage across the diode, k is Boltzmann's constant, and T is the absolute temperature.

Since $I_0 = B\exp(-E_g/kT)$, substituting in eqn (1) and on simplification

$$I = B\exp(-E_g/kT + eV/kT).$$

For current to be constant, $eV/kT - E_g/kT = C$

On rearrangement of above above equation may be written as $T = (e/kC)V - E_g/kC$, which is a linear equation i.e. equation of straight line having slope $a = e/kC$ and intercept $b = -E_g/kC$. Dividing b by a band gap may be written as

$$E_g = -(b/a). \qquad \ldots(2)$$

Current and Voltage are measured using digital Micro- ammeter and digital Voltmeter respectively. The diode under investigation is to be connected to the main unit. With the help of Hot air oven and oil, temperature of sample is raised and corresponding voltages are measured. From Slope (a) and intercept (b) of graph between voltage and temperature, *Energy Gap* is calculated using eqn (2).

INSTRUMENT *The apparatus consists of main unit having digital voltmeter (0-9.99V dc) and micro ammeter (0-999 µA dc), Digital Temperature Indicator, highly stabilized variable power supply, Samples (Ge, Si, LED), Energy controlled hot air oven, Silicon Oil and Thermocouple.*

Manufacturers:

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