Experiment 2

Band Gap Determination using Post Office Box

Aim

To find the band gap of the material of the given thermistor using post office box.

Apparatus Required

Thermistor, thermometer, post office box, power supply, galvanometer, insulating coil and glass beakers.

Principle and formulae

(1) Wheatstone's Principle for balancing a network $\dfrac{P}{Q} = \dfrac{R}{S}$

Of the four resistances, if three resistances are known and one is unknown, the unknown resistance can be calculated.
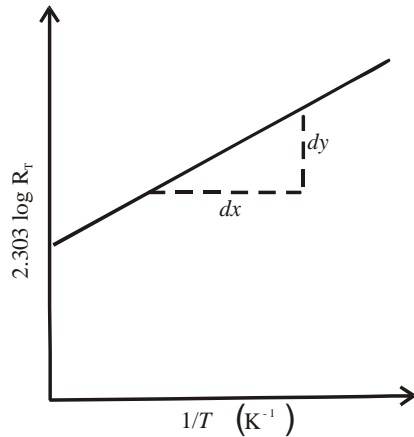
(2) The band gap for semiconductors is given by,

$$Eg = 2k\left(\frac{2.303\,log_e\,R_T}{\frac{1}{T}}\right)$$

where k = Boltzmann constant = 1.38×10^{-23} J /K

R_T = Resistance at T K

Table: To find the resistance of the thermistor at different temperatures

Temp. of thermistor T = t+273	$\dfrac{1}{T}$	Resistance in P	Resistance in Q	Resistance in R	Resistance of the thermistor $R_T = \dfrac{P}{Q} \times R$	2.303 log_{10} R$_T$
K	K^{-1}	ohm	ohm	Ohm	ohm	ohm
305	0.00327869	10	10	946	946	?
310	0.00322581	10	10	740	740	?
318	0.00314465	10	10	528	528	?
328	0.00304878	10	10	400	400	?
333	0.00300300	10	10	360	360	?
343	0.00291545	10	10	300	300	?
353	0.00283286	10	10	259	259	?
358	0.00279330	10	10	200	200	?
363	0.00275482	10	10	179	179	?
371	0.00269542	10	10	173	173	?

Model Graph

Observation

A graph is drawn between $\frac{1}{T}$ in X axis and 2.303 log R_T in Y axis where T is the temperature in K and R_T is the resistance of the thermistor at T K.

From graph, slope = (dy / dx) = ……

Band gap $(Eg) = 2k \times$ slope of the graph $= 2k \times (\frac{dy}{dx})$

where K = Boltzman's constant.

Assignment Question:

1. By using the readings in the tabular coloum (R_T), calculate the 2.303 x log_{10} R_T and enter the values in minimum four decimal points in the last coloum of the tabular coloum in your observation note book.

2. Draw the graph between $\frac{1}{T}$ in X axis and 2.303 log_{10} R_T in Y axis, where T is the temperature in K and R_T is the resistance of the thermistor at T K. From the graph find out slope dy/dx.

3. By using the slope value, calculate the band gap of the given thermistor and write the result in terms eV.

Finally, submit the scanned copy of your observation note book in GCR on (or) before THREE working days from the date of experiment.