Contents

Thermo electric effect

- Thermoelectric effect is the phenomenon of production of electrical energy from thermal energy.

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The effects of thermoelectric effect are:

- Seeback effect

- Peltier effect

- Thomson effect

Thermocouple

- Thermocouple is a pair of dis similar metallic wires joined at the end.

Thermo electric series

Work Function

- Work function is the minimum amount of work to be done to just remove the valance electron from an atom.

  - In photoelectric effect electrons are removed by photons.

Definition

- Thermoelectric series is the arrangement of metals.

- A pair metals in the series form a thermocouple.

- Current flows from former to later in the cold junction.

The thermoelectric series is:

- **Antimony** > **Iron** > **Zinc** > **Silver** > **Lead** > **Copper** > **Platinum** > **Bismuth**

- The thermoelectric effect of lead is almost 0 .

- Lead is taken as the reference metal in the series.

- **Relation:** The greater the separation of metals in the series the greater is the thermal emf produced.

    - Antimony Bismuth thermal $e.m.f$ is preferred.

Seeback effect

- Seeback effect is the phenomenon of production of electrical energy by keeping the two junctions of thermocouple at different temperatures.

- **Thermo** $e.m.f$. Thermo emf is the emf produced by keeping the junctions of a thermo-couple at different temperatures.

- **Thermo current**: Thermo current is the current produced by keeping junctions of a thermocouples at different temperatures.

Factors affecting emf and current in thermocouple

The magnitude and direction of current and emf in a thermocouple depend on:

- nature of metals forming thermocouples.
- temperature difference between the two junctions.

Cause of seeback effect

The cause of seeback effect are illustrated below:

- Seeback effect occurs due to:

    - diffusion of electrons form low work function to high work function.

- The diffusion rate depends on temperature difference between the junction.
- There is net thermo emf at different temperature of the junctions.

    - The diffusion rate is higher at hot junction.

    - The diffusion rate is same for both junction at same temperature.

         * The contact emf of both junction is same at same temperature.

         * There is no net themro emf at same temperature.

Reversibility of Seeback Effect

- Seeback effect is reversible effect.
    - The direction of thermo electric current reverses on changing hot and cold junctions.

Pelteir Effect

Statement:

- When electric current is passed through the thermocouple having both junctions at same temperature, heat is evolved at one junction and absorbed at another junction.

The factors affecting amount of heat are:

- Heat is directly proportional to current.

$$H \alpha I$$

- Heat doesnot depend on resistance.

Cause of Peltier effect

Condition for provision of energy to the junction

The condition for the provision of energy to the junction in thermocouple is

- Flow of current from higher potential to lower potential

Condition for provision of energy by the junction

The condition for the provision of energy by the junction is

- Flow of current from lower potential to higher potential

Reversibility of Peltier effect

Peltier effect is reversible effect.

Cause of reversibility of peltier effect

The cause of reversibility of peltier effect is

- The hot and cold junctions of thermocouple are interchanged.
- The hot and cold junctions of thermocouple are interchanged on changing the polarity of source.
- The hot and cold junctions of thermocouple are interchanged on changing the direction of current.

Variation of thermo emf with the temperature of hot junction

Setup of experiment of variation of thermo emf with the temperature of hot junction

Junctions present in the setup of experiment of variation of thermo emf with temperature of hot junction   The junctions present in the setup of experiment of variation of thermo emf with temperature of hot junction are

- The hot junction
- The cold junction

Major experimental instrument of experiment of variation of thermo emf with the temperature of hot junction   The major experimental instrument of experiment of variation of thermo emf with the temperature is

- Thermocouple

Mediums of junction in experimental setup for verification of thermo emf with the temperature of hot junction

The mediums of junction are

- Melting ice
- Hot oil Bath

Temperature of cold junction in experimental setup for the verification of thermo emf with the temperature of hot junction

The temperature of cold junction in experimental setup of variation of thermoemf is

- Constant

Instrument for measurement of temperature of hot junction in experiment of variation of thermo emf with the temperature of hot junction

The instrument for measurement of temperature of hot junction is

- Themometer

Working Principle of experiment of thermo emf with the temperature of hot junction

- One junction is at cold bath.
- One junction is at hot bath.
- The temperature of hot bath is increased.
- The increment of temperature is done gradually.

Observation of experiment of thermo emf with the temperature of hot junction

Resultant condition of same temperature of both junctions of thermocouple in experiment of variation of thermo emf

The resultant condition of same temperature of both junctions is

- Galvanometer shows no deflection.
- Thermo emf is not produced.

Neutral temperature

Abbreviation of neutral temperature in the experiment of thermo emf with the temperature of hot junction

The abbreviation of neutral temperature is

$$\theta_n$$

Condition at neutral temperature of hot junction in the experiment of thermo emf with the temperature of hot junction

The condition for neutral temperature of hot junction in the variation of thermo emf is

- Temperature at the instant of maximum production of thermo emf.

Factors affecting neutral temperature in thermocouple

The factors affecting neutral temperature in thermocouple are

- The nature of thermocouple.
- The properties of the material of thermocouple are under consideration in nature of thermocouple.

Factors not affecting neutral temperature in thermocouple

The neutral temperature in thermocouple is not affected by

- Temperature of hot junction

Temperature of inversion

Abbreviation for the temperature of inversion in the experiment of variation of thermo emf with the temperature of hot junction

The abbreviation of temperature of inversion is

$$\theta_i$$

Interval for condition for temperature to tend to temperature of inversion in observation of the experiment in variation of thermo emf with the temperature of hot junction

The interval of temperature tending to the temperature of inversion is

- The temperature interval after neutral temperature.

Magnitude of thermo emf at temperature of inversion in observation of the experiment in variation of thermo emf with the temperature of hot junction

The magnitude of thermo emf at temperature of inversion is

- Zero

Sign of thermo emf after the increment of temperature beyond the inversion temperature in experiment of variation of thermo emf with the temperature of hot junction

The sign of thermo emf after the increment of temperature beyond inversion temperature is

- Negative

Factors affecting the temperature of inversion in variation of thermo emf

The factors affecting the temperature of inversion in variation of thermo emf are

- The nature of thermo couple
- The temperature of cold junction

Graphical analysis of the variation of thermo emf with temperature of hot junction

Nature of graph of variation of thermo emf with the temperature of hot junction

The nature of graph of variation of thermo emf with the temperature of hot junction is

- Sinosudial

Shape of graph of variation of thermo emf with the temperature of hot junction

The shape of graph of variation of thermo emf with the temperature of hot junction is

- Symmetrical parabola

Quantities expressed in variation of thermo emf with temperature

Expression Magnitude of thermo emf in variation of thermo emf with temperature The magnitude of thermo emf in variation of thermo couple with temperature is

$$E$$

Representation of constants in the expression for variation of thermo emf with temperature The constants are

$$a, b$$

Expression for Magnitude of temperature in the graph of varitaion of thermo emf with temperature The magnitude of temperature is

$$\theta$$

Expression for Magnitude of neutral temperature The magnitude of neutral temperature is

$$\theta_n$$

Expression for Magnitude of inversion temperature   The magnitude of inversion temperature is

$$\theta_i$$

Expression for Magnitude of temperature of cold junction   The magnitude of expression for temperature of cold junction is

$$\theta_c$$

Expression for magnitude of thermo electric emf in the equation of parabola in the variation of thermo emf with temperature   The expression for magnitude of thermo electric emf in the equation of parabola is

$$E = \alpha\theta + \frac{1}{2}\beta\theta^2$$

Derivation for expression for magnitude of general neutral temperature in variation of thermo emf with temperature   The graph is a symmetrical parabola

$$\theta_i - \theta_n = \theta_n - \theta_c$$
$$\theta_n = \frac{\theta_c + \theta_i}{2}$$

Expression for magnitude of general neutral temperature in variation of thermo emf with temperature   The expression for the magnitude of general neutral temperature in variation of themro emf with temperature is

$$\theta_n = \frac{\theta_c + \theta_i}{2}$$