(MP3-6) Peltier's Effect

Aim of experiment

Determination of Peltier's Constant.

Apparatus

A.C Power Supply - D.C Power Supply – Rheostat – Ammeters for A.C and D.C – Thermocouple, Amplifier, or Micro voltmeter.

Theory of experiment

When a current flows through a thermocouple circuit, a temperature difference ΔT is set up between the junctions, eg. cooled and heated in *figure1*, the magnitude of which is proportional to that of the current

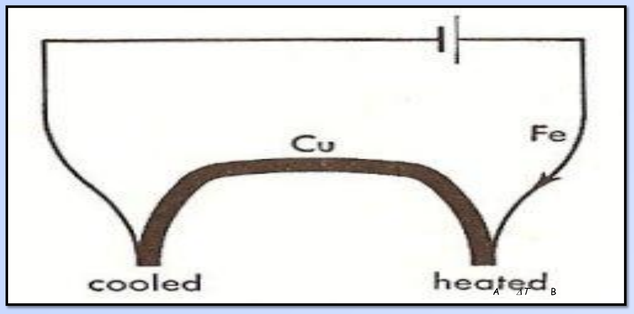

Figure 1. Junctions cooled and hooted are connected through a power supply

The junction at the lower temperature, is determined by the combination of metals and the direction of the current.

The flow of current additionally produces joulean heat in the circuit by the normal joule effect. The quantity of Joulean heat produced by this is proportional to RI^2 and is independent of the direction of the current. This joulean heat also causes a rise of temperature, so that finally the change of temperature ΔT measured at one junction is

$$\Delta T = k_1 RI^2 \pm k_2 I$$

Since the thermoelectric voltage is proportional to the change of temperature, thus

$$U_{DC} = k'_1 RI^2 \pm k'_2 I \qquad \textbf{(1)}$$

Where, k'_1 is proportionality constant, and k'_2 is Peltier constant. In case of alternating current, the resulting temperature is due to Joule effect only

$$U_{AC} = k'_1 RI^2 \qquad \textbf{(2)}$$

Subtracting (2) from (1), one get

$$U_{DC} - U_{AC} = k'_2 I \qquad \textbf{(3)}$$

Figure 2 shows a sketch of the circuit diagram

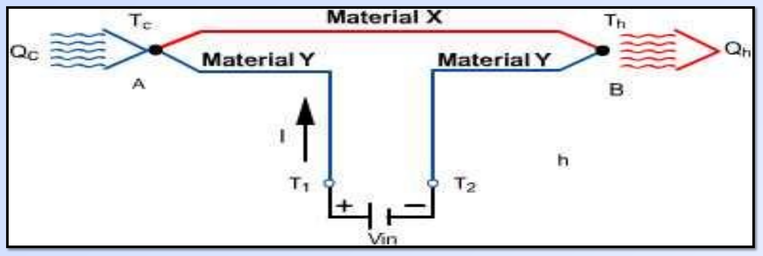

Figure 2. A sketch of the circuit diagram where A and B are Cold and hot junctions.

Procedure

1. Connect the circuit as shown in *figure 2.*
2. Put on the D.C power supply at first, change the current in steps of 20 mA between 0 and 400 mA and record the thermoelectric voltages.
3. Put on the A.C power supply, change the current in steps of 20 mA between 0 and 400 mA and record the thermoelectric voltages.
4. Subtract the direct thermoelectric voltages from alternating thermoelectric voltages.
5. Draw a graph between U_{DC} - U_{AC} on y-axis and I on x-axis, a straight line is obtained from which find the slope, which equals Peltier constant.

Results

I (mA)	U_{DC} (Volt)	U_{AC} (Volt)	U_{DC} - U_{AC} (Volt)

$Slope = k'_2 =$ $V.K^{-1}$