THERMOELCTRIC MATERIAL PROPERTY

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The thermoelctric material property refers to phenomena in which temperature diffrence creates electricity and elctricity will create temperatur diffrence .

> Any conversion of heat into electricity needs different phase transition such as

HEAT -------MEACHANICAL -------ELECTRICAL

But it will loss more ammount of energy as suppose if heat has 100% energy and after conversion into electrical it left very small.

But by thermoelectric effect effect we will directly convert heat into elctricity so that minimum loss will happen.

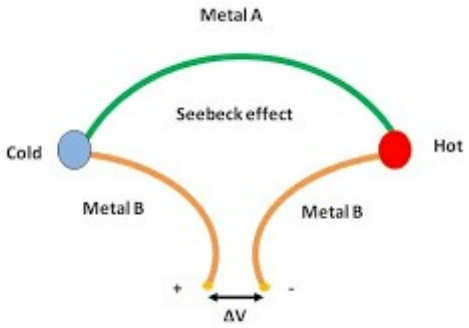
1. THERMOELECTRIC MATERIAL

* Temperature difference is directly proportional to voltage generated

* $(\Delta T) \sim V$

* Two different metal join from both the side and from one side we will provide heat and other side it will be cold then by voltmeter we can check the voltage generated in the loop .

* The main cause for voltage generation is if we heat from one side then electron will move far away from that side that will generate the voltage diffrence between two sides .



NOW BIG QUESTION ARISE ?

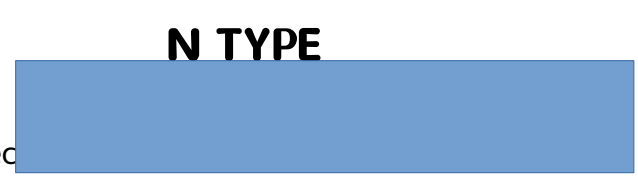
Q . if supoose electron are transferred from one side to another side then electrons are transfering so it says that metal is good conductor of electricity and heat but if metal is good conductor of heat and electricity it should transfer heat then how could you manage to create temperature diffrence ?

Soln _ The solution of problem is semiconductor it will only transfer electrons not heat.

1 various small cells are there which are in series .

2 thermal surface is in parrallel

3 upto 1000 degree celcius it can heat .



but problem is that it will only provide us 5-10 % efficiency but it is also useful in large scales .

2 . USES OF THERMOELECTRIC DEVICES

* It is widely used in deep space research organisations

* For example if someone has to go to pluto for research then there is no source of sunlight for gaining energy so from where we will make energy ?

* then heat souce radiation is used of plutoniu, 500. celcius in which radioactive sheilding will become hot and generate energy .

* It uses the phenomena of black body radiation .

3 . TYPES OF EFFECT GENERATED BY THIS

* **SEEBACK EFFECT**
* **PELTIER EFFECT**
* **THOMSON EFFECT**

1 . SEEBACK EFFECT

Two diffrent metals are taken such as IRON and COPPER then we will join both metals together and supply heat from one side and other side is at normal temperature it will generate the voltage diffrence and electricity is generated from it to uses it in daily life .

There are two metal one flow current in anti clock wise one in clock wise so whoever dominates will flow current in that direction .

$S = \Delta V / \Delta T$

where ΔT is the temperature difference between the two ends of a material and ΔV is the thermoelectric voltage generated. So that the voltage generated is given by:

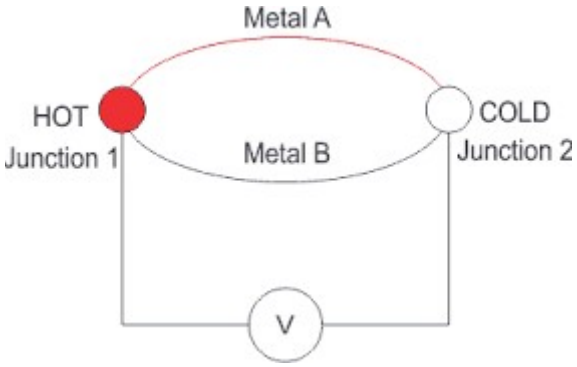
$$\Delta V = S*\Delta T$$

Ideal thermoelectric materials should have the following properties:

- High Seebeck coefficient **S** - to get the maximum output voltage per degree of temperature difference.
- High electrical conductivity σ - to minimise Joule heating
- Low thermal conductivity λ - to restrict the diffusion of the heat across the device in order to maintain a large temperature gradient.

The figure of z also useful in calculation of efficiency

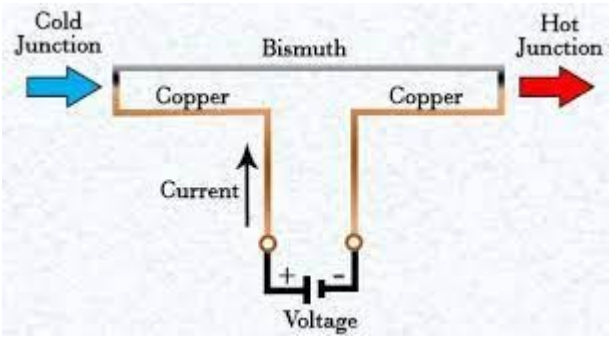
$$Z = \underline{\sigma S^2} / \quad \lambda$$



2 PELTIER EFFECT

This effect is the reverse of seeback effect in which we will provide the potential diffrence and the heat will be generated from one side and cold will be generated from other side . This will be useful in cooling the materials .

Works as refrigirator and airconditioners and also heaters .



3 . THOMSON EFFECT

In thomson effect we heated the metal from the centre and also provide the voltage diffrence . Then we noticed diffrence things opon investigating on it

for example :

IRON ROD

It will heat from + terminal side which will be opposite of peltier effect so it is -ve thomson effect .

COPPER BAR

It will heat from negative terminal side as obious then it will called as +ve thomson effect .

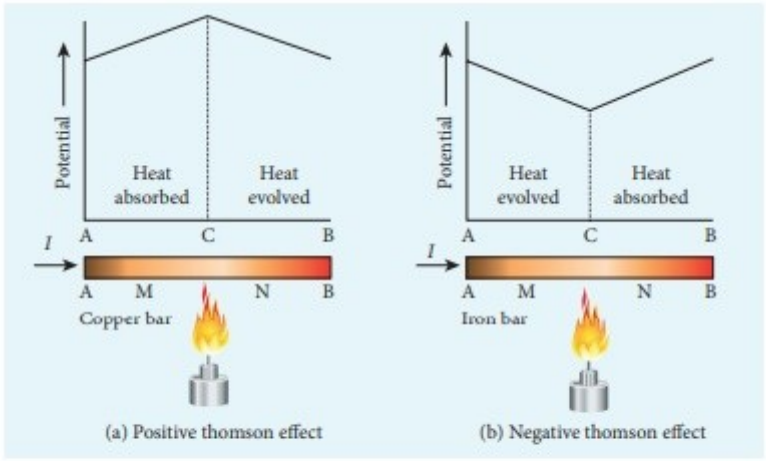
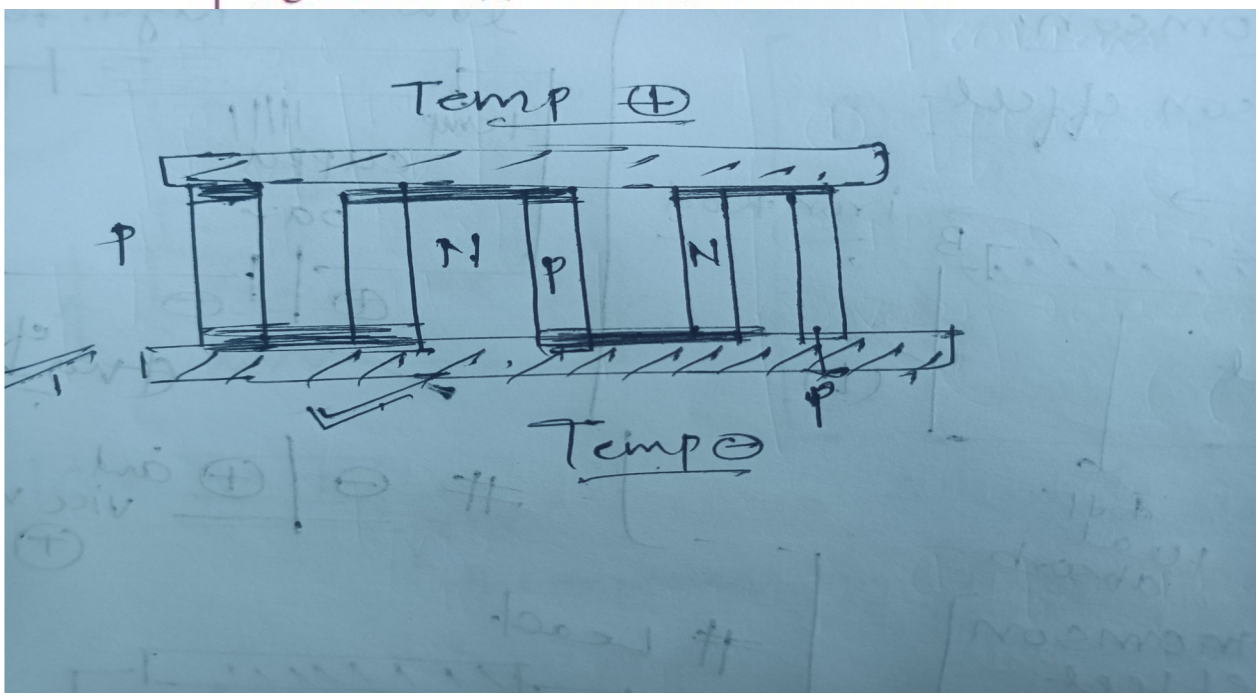
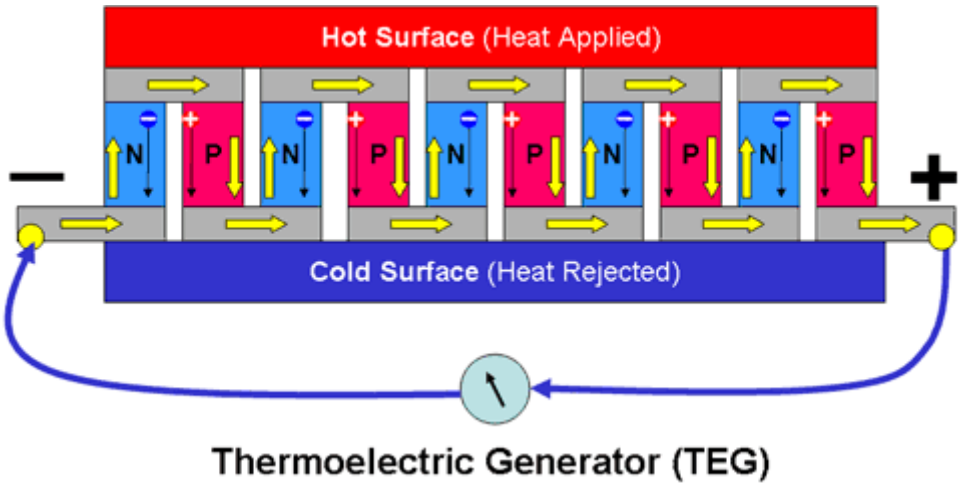


Figure 2.37 (a) Positive Thomson effect



CONNECTIONS OF SEMICONDUCTOR IN SERIES



Thermoelectric Generator (TEG)