TOTAL EMF

Let us consider a thermocouple, composed of conductors X and Y. Let the current be positive from X to Y at the hot junctions and the temperatures of the hot and cold junctions be T_1 and T_2 respectively.

The total emf responsible for the thermocurrent must be the sum of potentials due to Peltier and thomson effects.

Let π_1 and π_2 be the Peltier coefficients at the junctions at T_1 and T_2 respectively and σ_x and σ_y be the Thomson coefficients for the metals X and Y respectively. When the electric charge flows in the thermocouple, the heat is absorbed and evolved at the junction due to Peltier effect and all along the conductor due to Thomson effect.

The total emf round the circuit ε is the energy gained by unit charge

THERMOELECTRIC POWER

when passing round the circuit.

$\therefore$ E_0 = Sum of pds. across various parts of the circuit

$$= \pi_1 - \pi_2 + \int_{T_2}^{T_1} \sigma_x \, dT - \int_{T_2}^{T_1} \sigma_y \, dT$$

$$= \pi_1 - \pi_2 + \int_{T_2}^{T_1} (\sigma_x - \sigma_y) \, dT \quad \text{——— (1)}$$

It is equal to the total Seebeck emf available in the circuit.

Considering the temperature of cold junction T as constant, the temperature of hot junction is varied. The variation of emf with the temperature of hot junction may be obtained by differentiating relation (1) with respect to T, as

$$\frac{dE}{dT} = \frac{d\pi}{dT} + (\sigma_x - \sigma_y) \quad \text{——— (2)}$$

This quantity is called the Thermoelectric power or relative Seebeck coefficient for the two metals and is denoted as P_{xy}