RAMAN ~~ROTATIONAL~~ SPECTROSCOPY

- * It involves scattering of the light.
- * Raman spectroscopy depend on physical phenomen called inelastic scattering discovered by Smekal in 1928 & then first observational experiment ma by C.V Raman in 1928.

Scattering: Refers to light deflected from the direc of incident light propogation.

There are three basic types of scattering

a) Elastic: Same frequency as the incident light - Rayleigh scattering

b) Inelastic: Lower frequency than that of the incident light - Stokes Raman Scattering.

c) Inelastic: Higher frequency than that of the incident light. antistokes Raman-scattering.

b/w molecule & incident light

When collision is inelastically the energy can be greater ~~than scattering light~~ or lesser of incident light causes the change in oscillation of atoms or molecule. This effect is known as Raman effect.

There are two theories

Classical theory or Polarizability theory

Raman effect may involve absorption or reemission of light due to scattering phenomenon. The classical polarizability theory was developed by G. Placzer in 1934, Interaction of light in this case depends upon polarizability of the molecule. The stretching vibration of a homonuclear diatomic molecules which donot have permanent dipole, deform the electronic charge. This alters the polarizability of the molecule & so the Raman effect is observed.

When a molecule is placed under the magnetic field. It causes distribution of the electronic charge hence induced dipole moment produced & molecule become polarized.

The induced dipole moment is given by

$$\mu_i = \alpha . E \quad ---- \quad eq①$$

α = molecular property (polarizability)

E = Intensity of the magnetic field.

But electric field experienced by molecule

$$E = E_0 \sin 2\pi \nu t \text{ ----- } ②$$

E_0 = amplitude of vibrating electric field.

ν = frequency

t = time

From eq ① & ②

$$\mu_i = \alpha \cdot E_0 \sin 2\pi \nu t \text{ ..... } ③$$

However, α is molecular property it varies as the molecule oscillates.

Hence,

$$\alpha = \alpha_0 + \beta \sin 2\pi \nu_0 t \text{ .... } ④$$

α_0 = Polarizability at equilibrium.

β = rate of change of polarizability

ν_0 = Vibrational frequency of molecule

$$\mu_i = (\alpha_0 + \beta \sin 2\pi \nu_0 t)(E_0 \sin 2\pi \nu t)$$

$$\mu_i = E_0 \sin 2\pi \nu t \cdot \beta \sin 2\pi \nu_0 t + E_0 \sin 2\pi \nu t \, \alpha_0$$

$$[\because \{\sin x \cdot \sin y = \tfrac{1}{2}(\cos(x-y) - \cos(x+y)\}$$