28/1/20

Unit - 1
Raman Spectroscopy

Raman Spectroscopy :- when a beam of light is pass through a trasparent substance a small amount of radiation energy is scattered, the scattering persisting (दृढ़ रहना) even if all dust particle or other extraneous metal are rigorously excluded (बाहर रखना) from the substance.

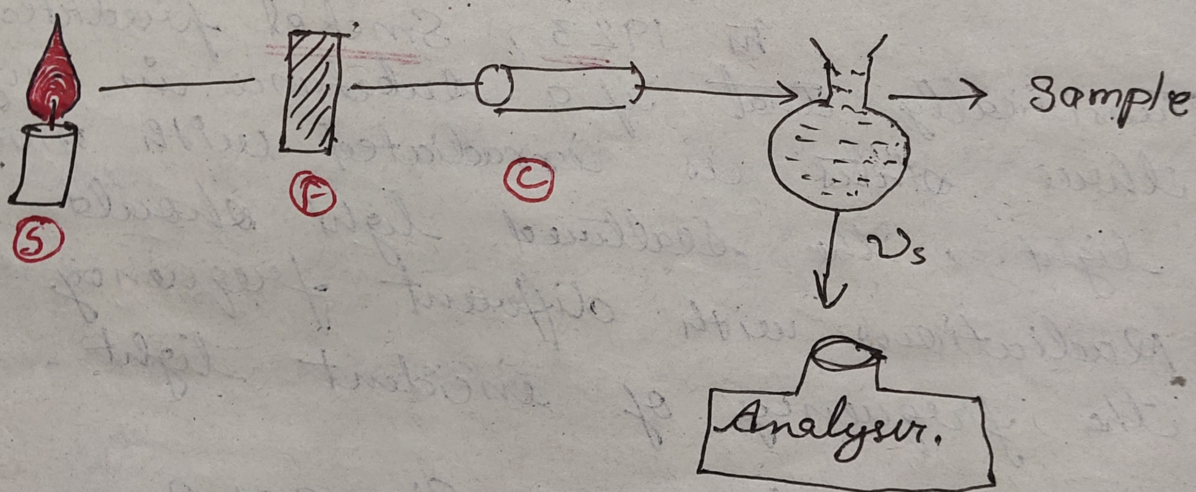


Fig. (1).

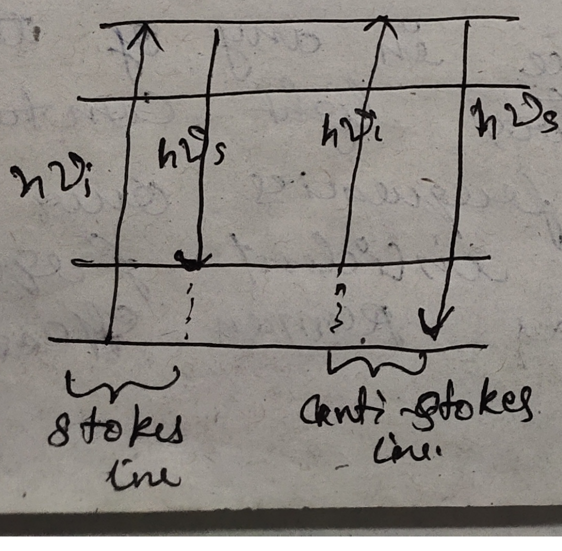


Fig (2)

Rayleigh observed that if a substance is irradiated with monochromatic light, the scattered light is observed in a direction at right angle to the incident light.

When a spectroscope was used to investigate the scattered light it was found that the frequency of scattered light was same as the frequency of the incident radiation. this phenomenon is known as Rayleigh scattering.

In 1923, Smekel predicted Theoritically that if a substance in any of the three states is irradiated with monochromatic light, the scattered light should contain radiations with different frequency than the frequency of incident light.

In 1928, Sir C.V. Raman discovered that when a beam of monochromatic light was allowed to pass through a substance in any of the three states the scattered light contaitns some additional frequencies over and above that of incident frequency. This is known as Raman Effect.

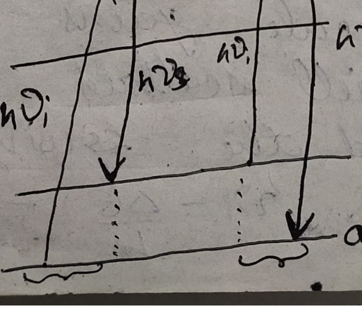
The lines whoes wavelenghts has been modified in Raman effect are called Raman lines. The lines having wavelenght greater then that of the incident wavelenght are called stokes lines and those having shorter wavelength are antistokes lines.

If ν_i is the frequency of incident radiation and ν_s is the frequency of Radiation scattered by the given molecular species, then the Raman shift $\Delta\nu$ is defined by the following relation

$$\Delta\nu = \nu_i - \nu_s \quad \text{—(1)}$$

The Raman shift doesn't depent upon the frequency of the incident light but it is regarded as characteristic of substance causing Raman effect.

For stokes lines. $\Delta\nu$ is posisitive.
and for antistokes lines $\Delta\nu$ is negative.



Stokes lines — antistokes lines. Fig (2).

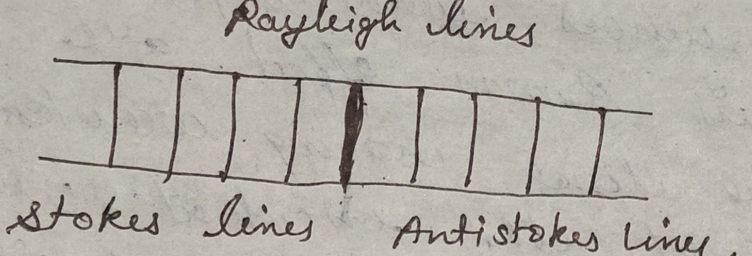


Fig (3).

Mechanism:—

- Incident photon of Energy $h\nu_i$.
- photones undergo collisions with molecul
- if collision is perfectly elastic they will be deflected unchange.
- if colloision b/w photon and molecules are inelastic, energy exchange will takes place b/w them.
- Molecule can gain or lose ~~molecular~~ ammount of energy only in accordance with the quantum laws:
  " Its energy change ΔE joules must be the difference in energy between two of its allowed states."
- i.e. ΔE must represent a change in the vibrational and/or rotational energy of the molecule.

$E = h\nu$

- If the molecule gains energy ΔE, the photon will scattered with energy $h\nu_i - \Delta E$ and the equivalent radiation have a frequency $\nu_i - \frac{\Delta E}{h}$ – Stokes.