

CARBON DI- OXIDE LASER

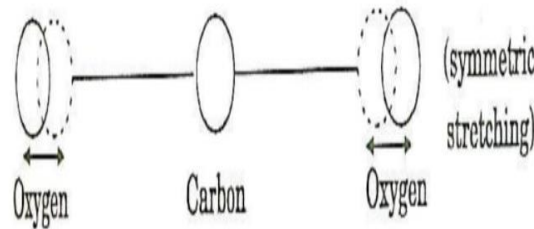
A carbon dioxide molecule has a carbon atom at the center with two oxygen atoms attached, one at both sides.

Modes of vibrations. They are

- Symmetric stretching mode.
- Bending mode
- Asymmetric stretching mode.

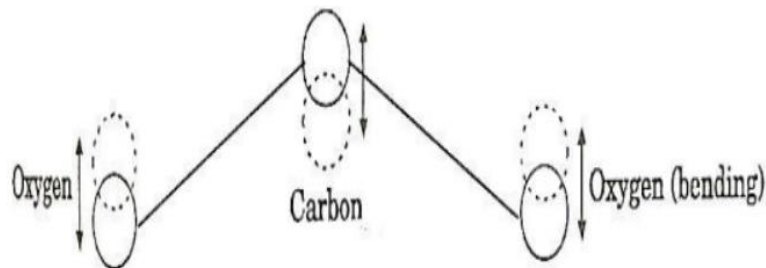
Symmetric stretching mode

In this mode of vibration, carbon atom is at rest and both oxygen atoms vibrate simultaneously along the axis of the molecule



Bending mode:

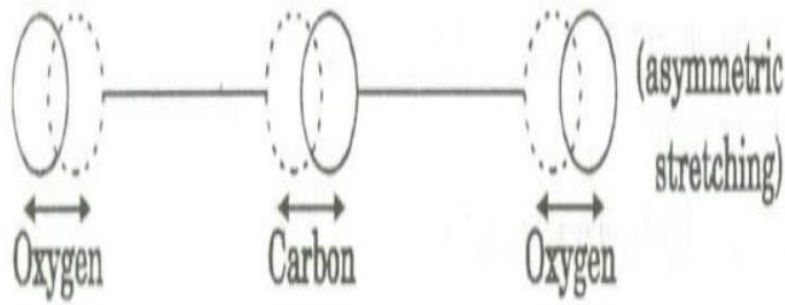
In this mode of vibration, oxygen atoms and carbon atoms vibrate perpendicular to molecular axis.



Asymmetric stretching mode

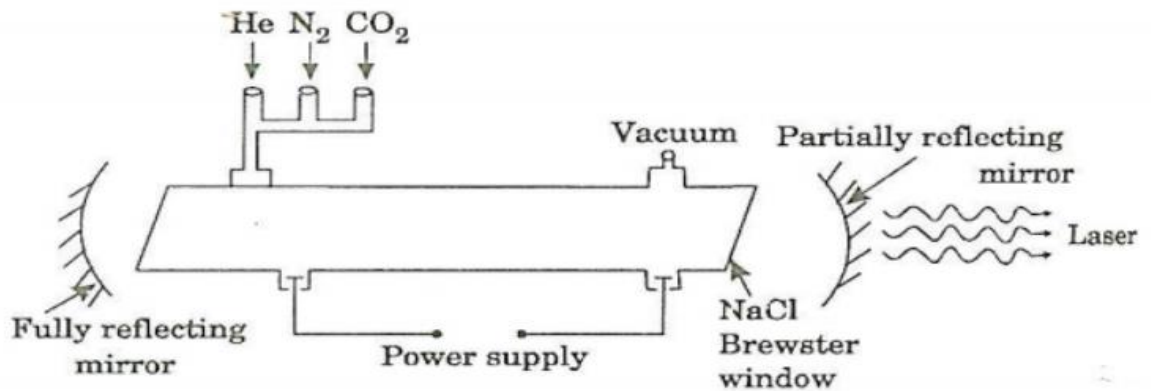
In this mode of vibration, oxygen atoms move in one direction while carbon atoms in the other direction.

c. Asymmetric stretching mode:

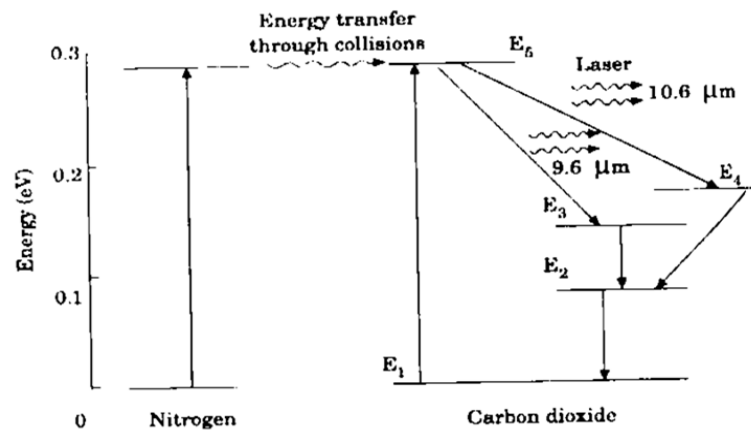


Construction:

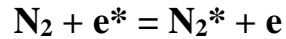
It consists of a quartz tube. This discharge tube is filled with gaseous mixture of CO₂(active medium), helium and nitrogen. The ends of the discharge tube are inclined at polarising angle to produce polarized light. This arrangement is called Brewster window. Two concave mirrors one fully reflecting and the other partially reflector to form an optical resonator.



Working:



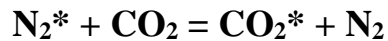
When electrical discharge is produced in the tube



N_2 = Nitrogen molecule in ground state e^* = accelerated electron

N_2^* = nitrogen molecule in excited state e = ordinary electron with lesser energy

Now N_2 molecules in the excited state collide with CO_2 atoms in ground state and excite to higher electronic, vibrational and rotational levels.



1. Transition E_5 to E_4 :

This will produce a laser beam of wavelength $10.6\mu\text{m}$

2. Transition E_5 to E_3

This transition will produce a laser beam of wavelength $9.6\mu\text{m}$. Normally $10.6\mu\text{m}$ transition is more intense than $9.6\mu\text{m}$ transition. The power output from this laser is 10kW

Characteristics:

1. Type: It is a molecular gas laser.
2. Active medium: A mixture of CO_2 , N_2 and helium is used as active medium
3. Pumping method: Electrical discharge method is used for Pumping action
4. Optical resonator: Two concave mirrors form a resonant cavity
5. Power output: The power output from this laser is about 10kW .
6. Nature of output: The nature of output may be continuous wave or pulsed wave.