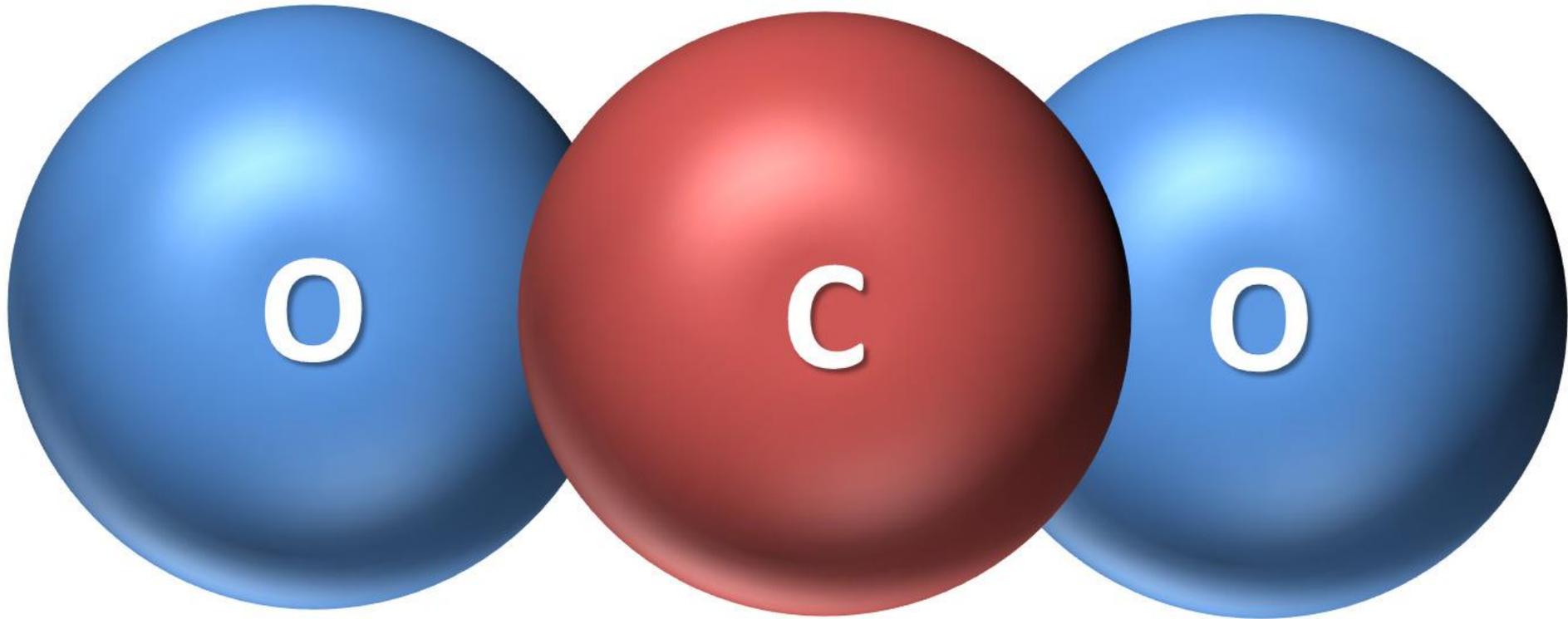


Carbon Dioxide (CO₂) Sensors



*By
Shridevi Bhat
25/03/2017*

Introduction

- Carbon dioxide is a colourless and odourless gas and is toxic if present in high levels.
- Carbon Dioxide sensors are devices used to measure the amount of carbon dioxide present in air or in a product.
- These sensors measures the amount of the gas in parts per million (ppm) or by percentage volume.
- Whenever CO₂ gas or dry ice is used, produced, shipped, or stored, CO₂ concentration can rise to dangerously high levels.
- Because CO₂ is odorless and colorless, leakages are impossible to detect, meaning proper sensors are needed to help ensure the safety of personnel.

CO₂ concentration guide

Effect of Different Levels of CO₂

CONCENTRATION	EFFECT
350 - 450 ppm	Typical atmospheric concentration
600 - 800 ppm	Acceptable indoor air quality
1,000 ppm	Tolerable indoor air quality
5,000 ppm	Average exposure limit over 8-hour period
6,000 - 30,000 ppm	Concern, short exposure only
3 - 8%	Increased respiration rate, headache
> 10%	Nausea, vomiting, unconsciousness
> 20%	Rapid unconsciousness, death

Types

Basically there are two types of carbon dioxide sensors used:

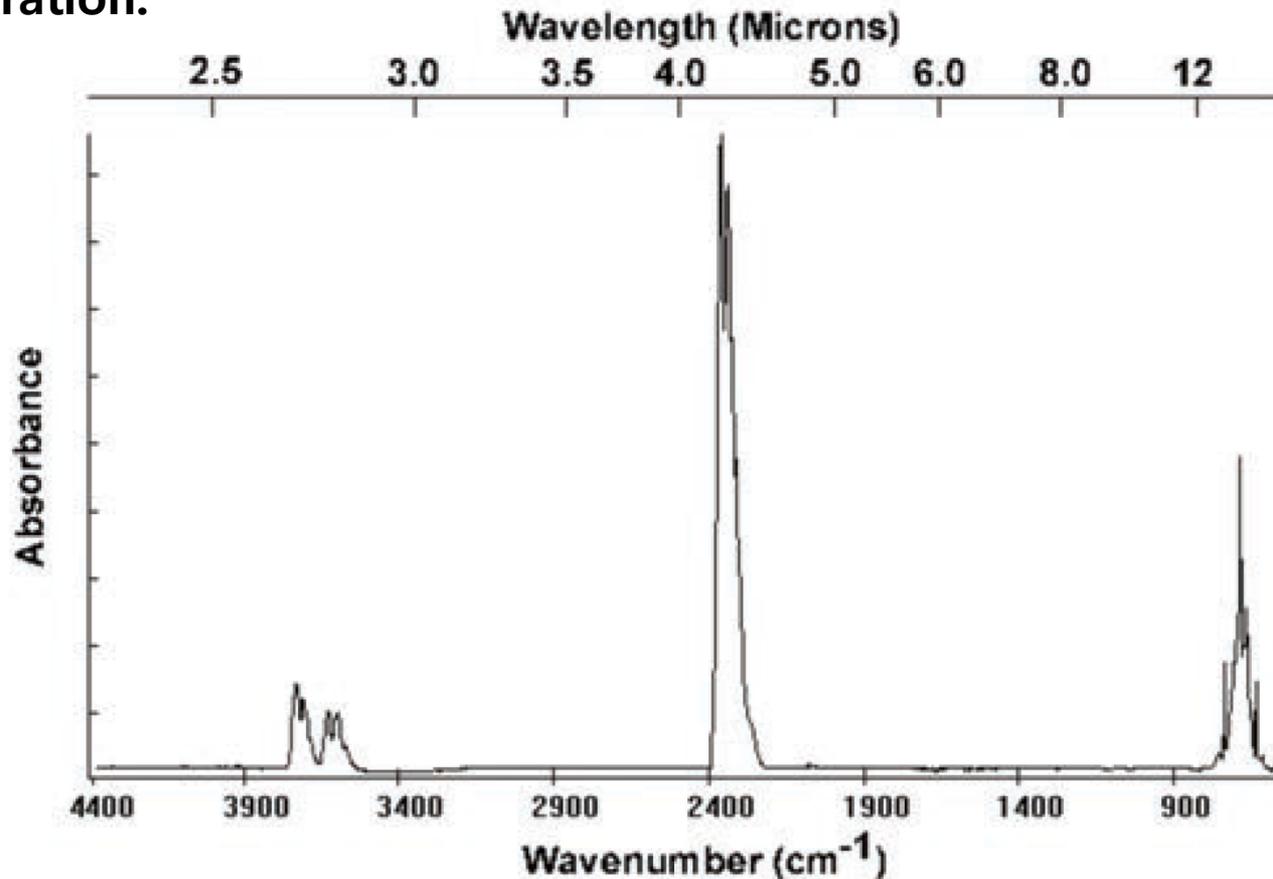
- 1. Non-Dispersive Infra Red (NDIR) Sensors**
- 2. Chemical based CO₂ Sensors**

Working principle of NDIR sensor

CO₂ has a strong absorbance at 4.26 μm (2350 cm⁻¹).

The CO₂ absorbance band is unique and therefore highly selective.

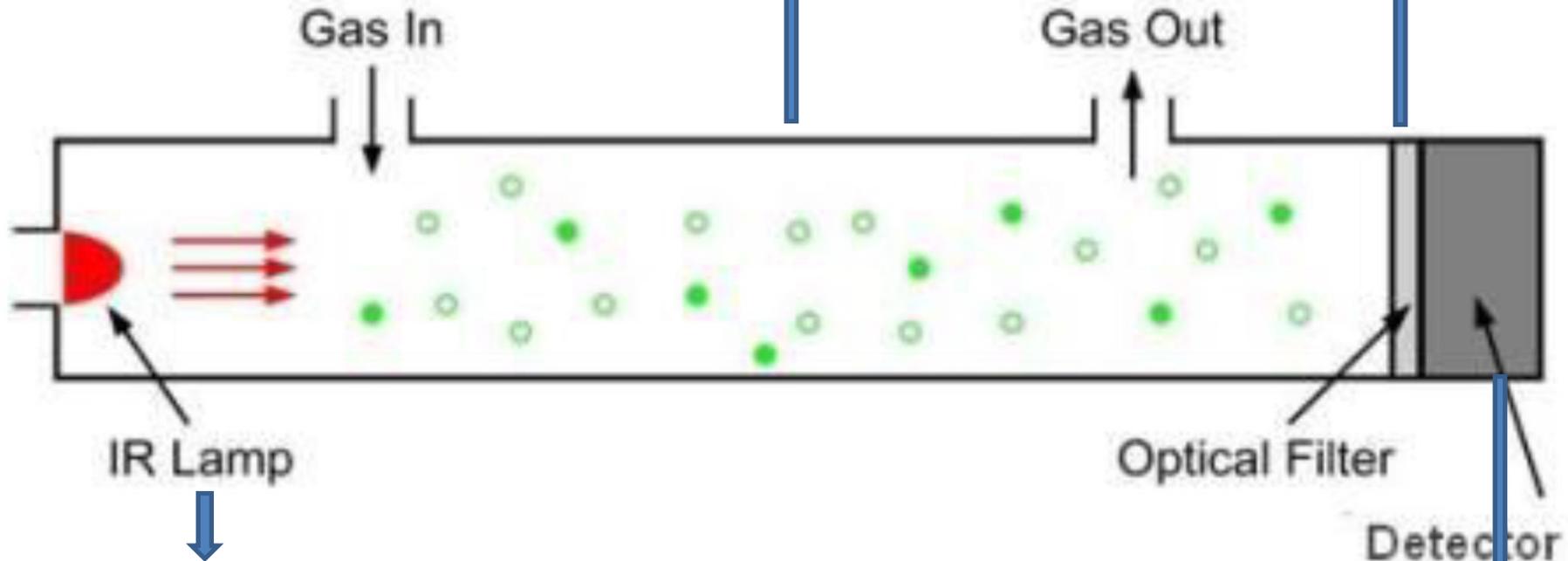
The amount of IR light absorbed is proportional to the concentration.



IR Spectrum of CO₂

Absorbs light except the light of wavelength absorbed by carbon dioxide molecules

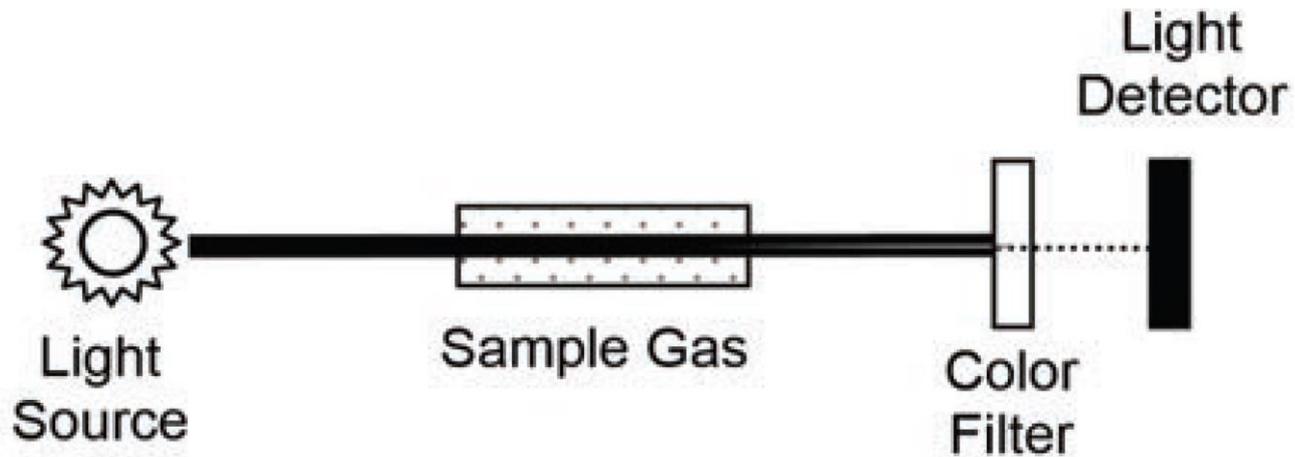
Tube filled with the gas



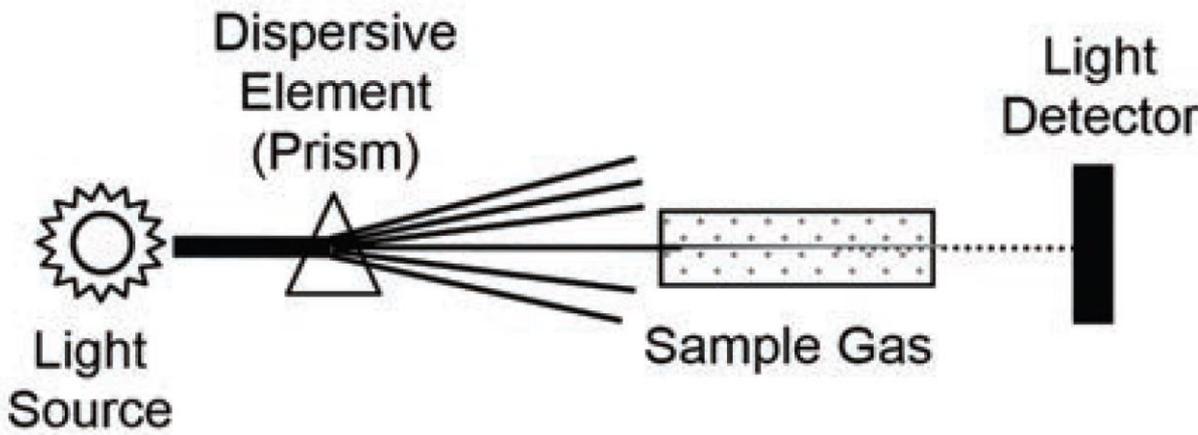
Directs the infrared waves of light

The difference between the amount of infrared light between the source and detector is proportional to the number of CO₂ molecules present in the gas

Non-dispersive vs. Dispersive Sensors



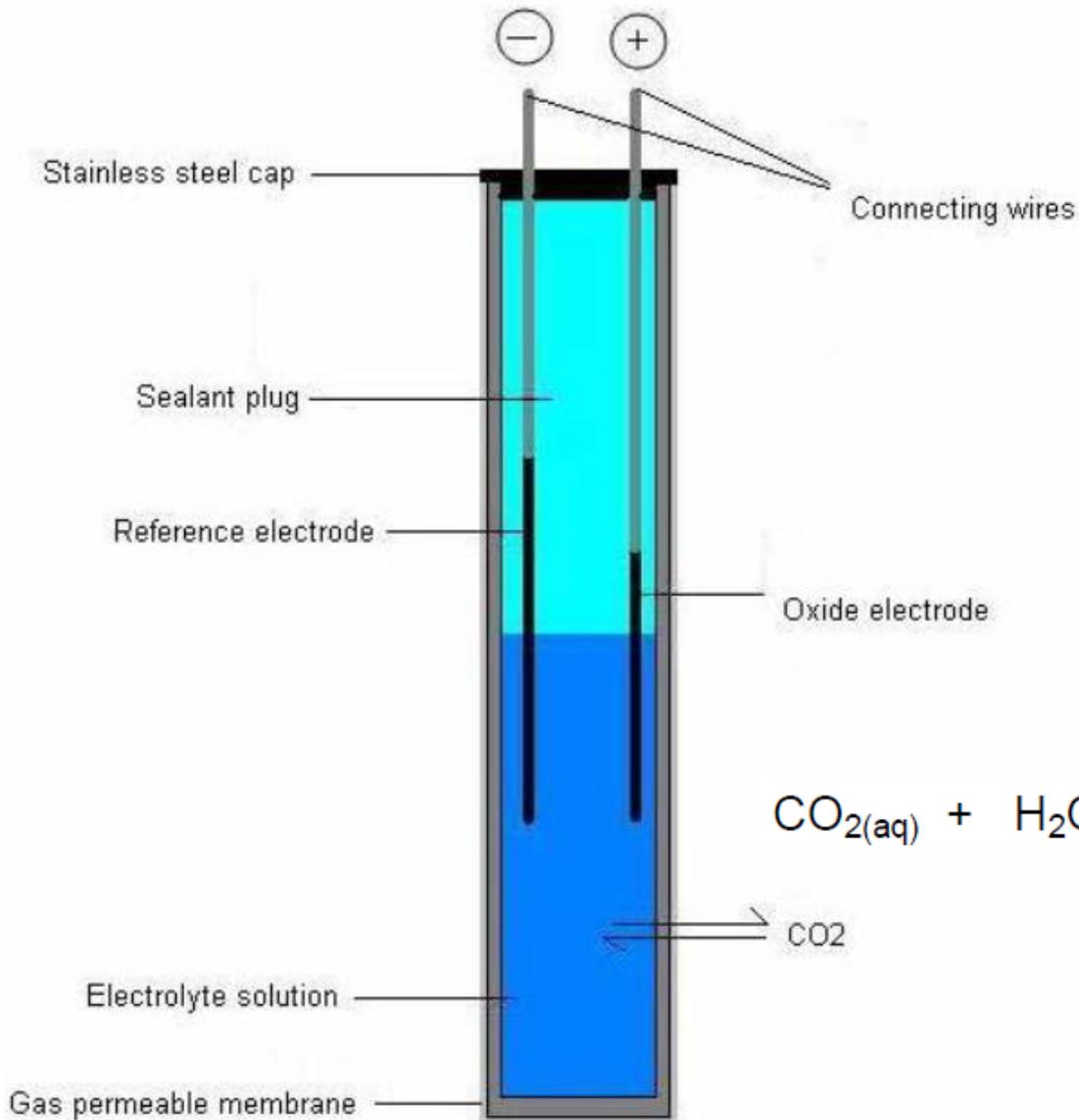
Non-Dispersive IR – all light goes through sample



Dispersive IR – only selected wavelength light goes through sample

Dispersive IR detectors are usually used in bench-top analytic instruments for their ability to scan a broad wavelength range. However, they tend to be larger, heavier, more complicated and more costly and therefore are less suitable for portable instruments.

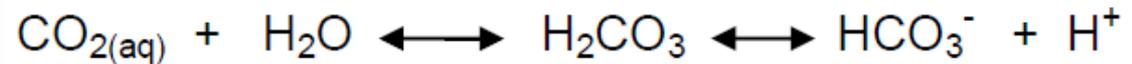
Working principle of chemical sensor



Based on the measurement of the pH change of the electrolyte solution caused by the hydrolysis of the CO₂.

It consists of a bicarbonate based electrolyte.

The CO₂ molecules present in the solution diffuse through this gas permeable membrane and enter into the internal electrolyte solution.



These proton ions decrease the pH of the electrolyte solution and which is detected by the internal electrodes.

Applications

- **Modified atmosphere**
- **Indoor air quality**
- **Stowaway detection**
- **Cellar and gas stores**
- **Marine vessels**
- **Greenhouse**
- **Landfill gases**
- **Confined places**
- **Cryogenics**
- **Ventilation management**
- **Mining**

References

- https://en.wikipedia.org/wiki/Carbon_dioxide_sensor
- <http://www.vaisala.com/Vaisala%20Documents/Application%20notes/CEN-TIA-Parameter-How-to-measure-CO2-Application-note-B211228EN-A.pdf>
- <http://www.pitt.edu/~qiw4/Academic/ME2082/Student%20presentations/S%20Atabek%20CO2%20SENSORS%202.pdf>
- <http://teaching.csse.uwa.edu.au/units/CITS4419/lectures/wk2.submissions/carbon-dioxide-sensors-puneet%20verma.pdf>

THANK YOU