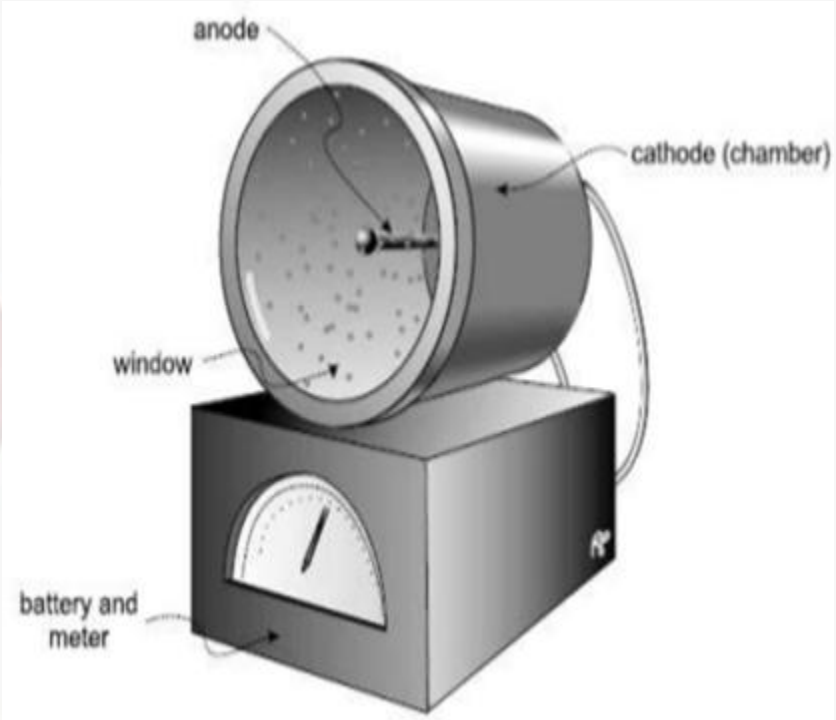
Ionization Chamber

Topics covered

- Basic principle of Ionization Chamber
- Construction of Ionization Chamber
- Working of Ionization Chamber
- Uses of Ionization Chamber
- Limitations of Ionization Chamber
- References

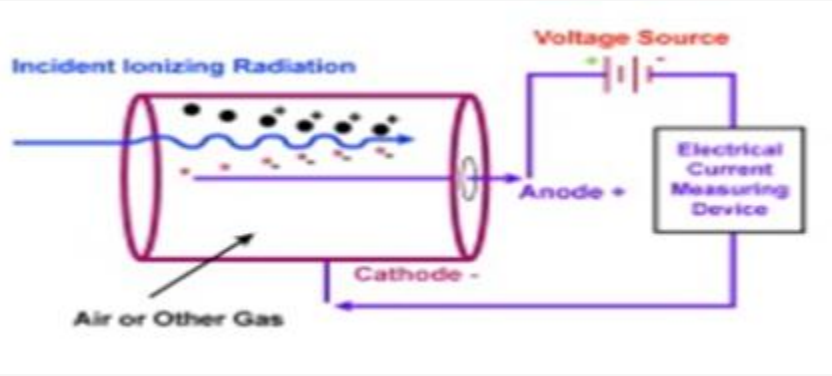
Introduction



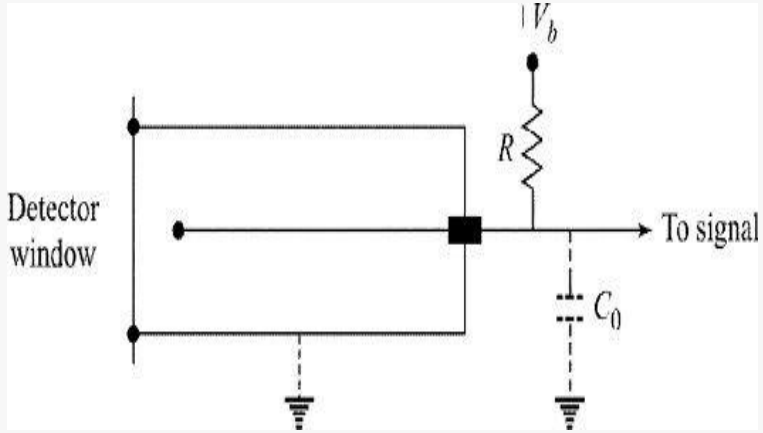
- Ionization Chamber is the simplest of all gas filled detector
- Widely used for detection and measurement X-rays, gamma rays and beta particles
- Conventionally the term "Ionization Chamber" used exclusively to describe those detectors which collect all the charges created by direct ionization within the gas through the application of an electric field

Principle of Ionization Chamber

Charged particles passing through the matter remove electrons from the atoms as they move along (process called ionization). If voltage is applied across the material, the electrons drift to one side and the leftover positively charged ions drift to the other.



Construction of Ionization Chamber



- The most commonly used are cylindrical in shape.

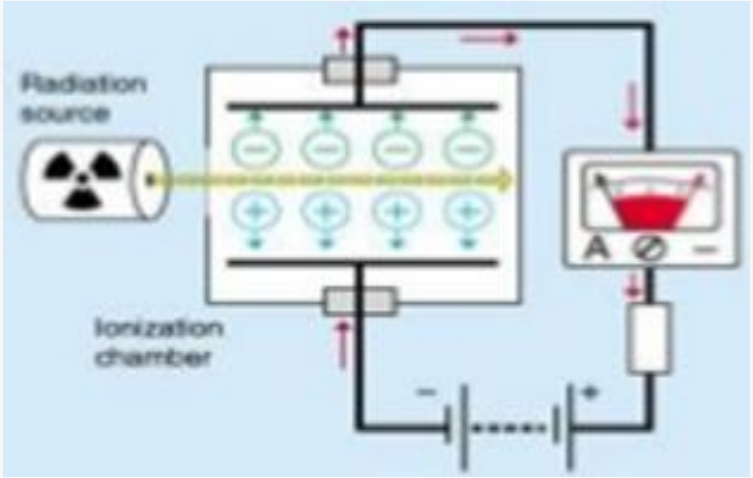
- The cylinder is made up of metal, which acts as a cathode

- In the centre of the cylindrical cathode, a straight conducting wire, which is insulated from the outer cylinder, acts as anode.

- The most common gas in ionization chamber is air. Other gases used in such a detector are He, Ne, isobutene, etc.

- The total gas pressure in the tube is generally less than one atmosphere.

Working of Ionization Chamber



•When incident radiations enter the ionization chamber, they ionize the gas present in the chamber, producing electrons and positive ions together known as electron-ion pairs.

• Under the influence of the electric field, electrons and ions move towards their respective electrodes.

•For a voltage gradient of 100 V cm^{-1}, ions at a speed of about 1 m/s in air at STP take about 0.02 s to cross a gap of ~2 cm.

•Electrons being lighter move about 1000 times faster and are collected at anode quickly.

•The electrons collected at anode constitute a current in the circuit. The number of electron-ion pairs produced in the gas and hence the current in the circuit is calculated as under.

Uses of Ionization Chamber

- It can measure accurately the energy of α-particles and other ions with discrete spectra
- It is most suitable to count α-particles in presence of β-particles and γ-radiations
- It may be used to count fissions. For example, a high resolution pulses produced by α-particles from ^{234}U to ^{238}U.
- Low fission rate can be measured in the presence of high α-particles.

Limitations of Ionization Chamber

- β-particles and γ-rays cannot be detected by it.
- It is useless when **high counting rates** are involved because after the detection of one particle, it has to wait several milliseconds, before it is ready to detect the next particle, known as dead time.
- It is not able to detect **low energy ionizing particles**.

References

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4. https://www.slideshare.net/anasyess1/ionization-chamber
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Thank you