SMOKE SENSORS

Smoke Detector

🔥 **Smoke Detecting Sensors**

❑ **Smoke detecting sensors are critical safety devices designed to detect the presence of smoke, a key indicator of fire.**

❑ **These sensors form the core of fire alarm systems in homes, offices, industrial plants, and public infrastructure.**

❑ **By identifying smoke particles in the air, these sensors can alert occupants early, allowing time for evacuation or firefighting efforts—saving lives and property.**

Fire Alarm System

A fire alarm system is a network of devices working together to detect and alert people about a fire.

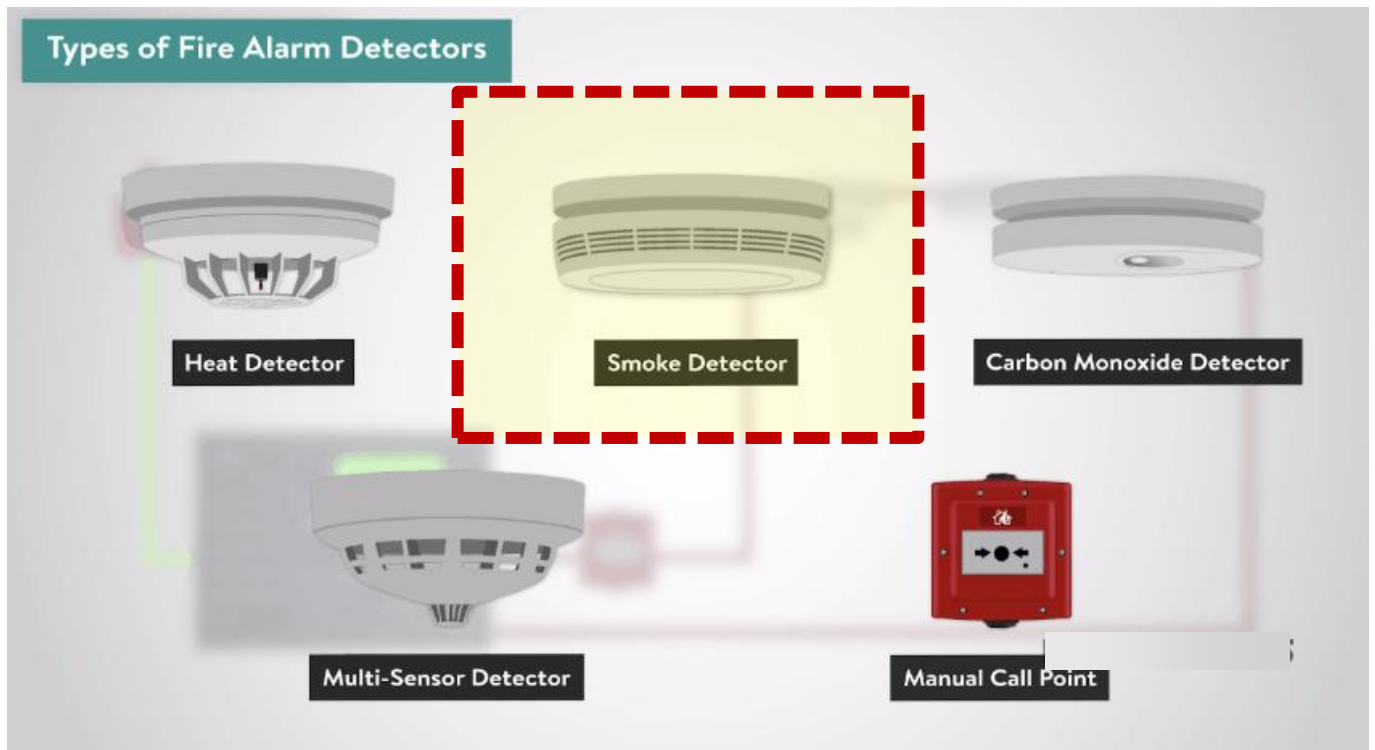**It includes sensors, control panels, and sounders that help initiate a prompt response to an emergency.**

❑ **Heat detectors**
❑ **Smoke detectors**
❑ **Carbon Monoxide detectors**
❑ **Multi-sensor detectors**
❑ **Manual Call Points**

Fire Alarm Control Panel

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Types of Fire Alarm Detectors

Heat Detector

Smoke Detector

Carbon Monoxide Detector

Multi-Sensor Detector

Manual Call Point

What is Smoke Detector

- A smoke detector is a device that senses smoke, typically as an indicator of fire.

- Commercial security devices issue a signal to a fire alarm control panel as part of a fire alarm system, while household smoke detectors, also known as smoke alarms.
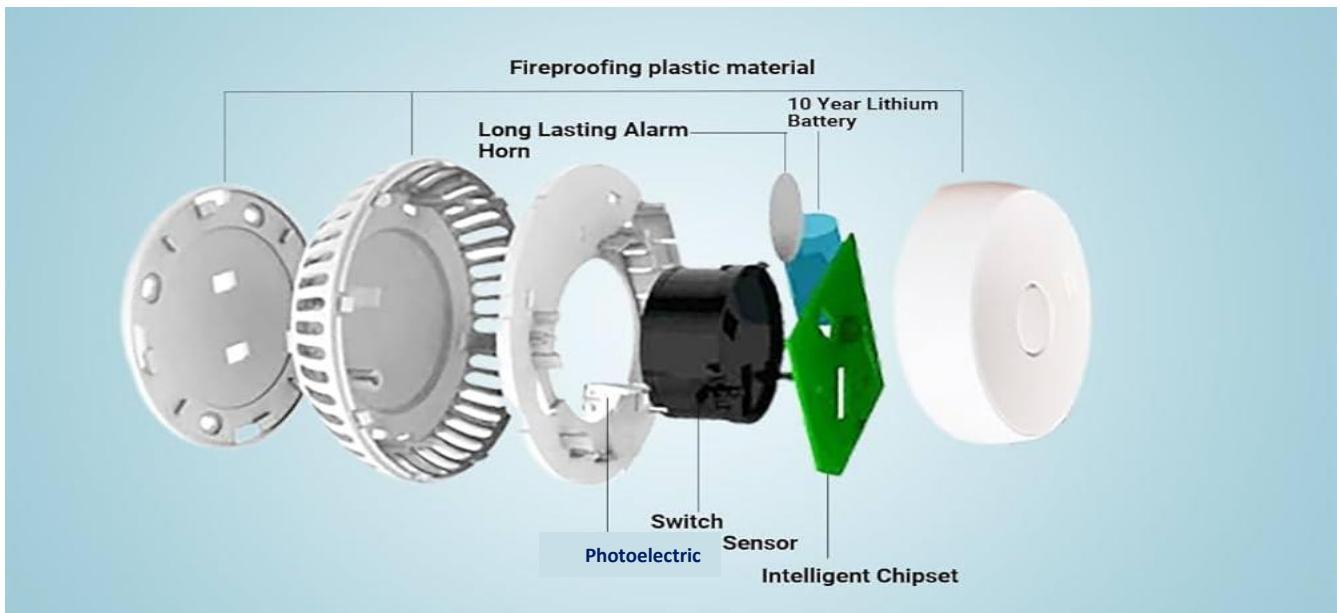
Why is it necessary?

- Protecting your home against fire.
- 45% of death rate is reduced when smoke detectors are present
- Early and accurate detection of fires is crucial to minimize damage and loss of life
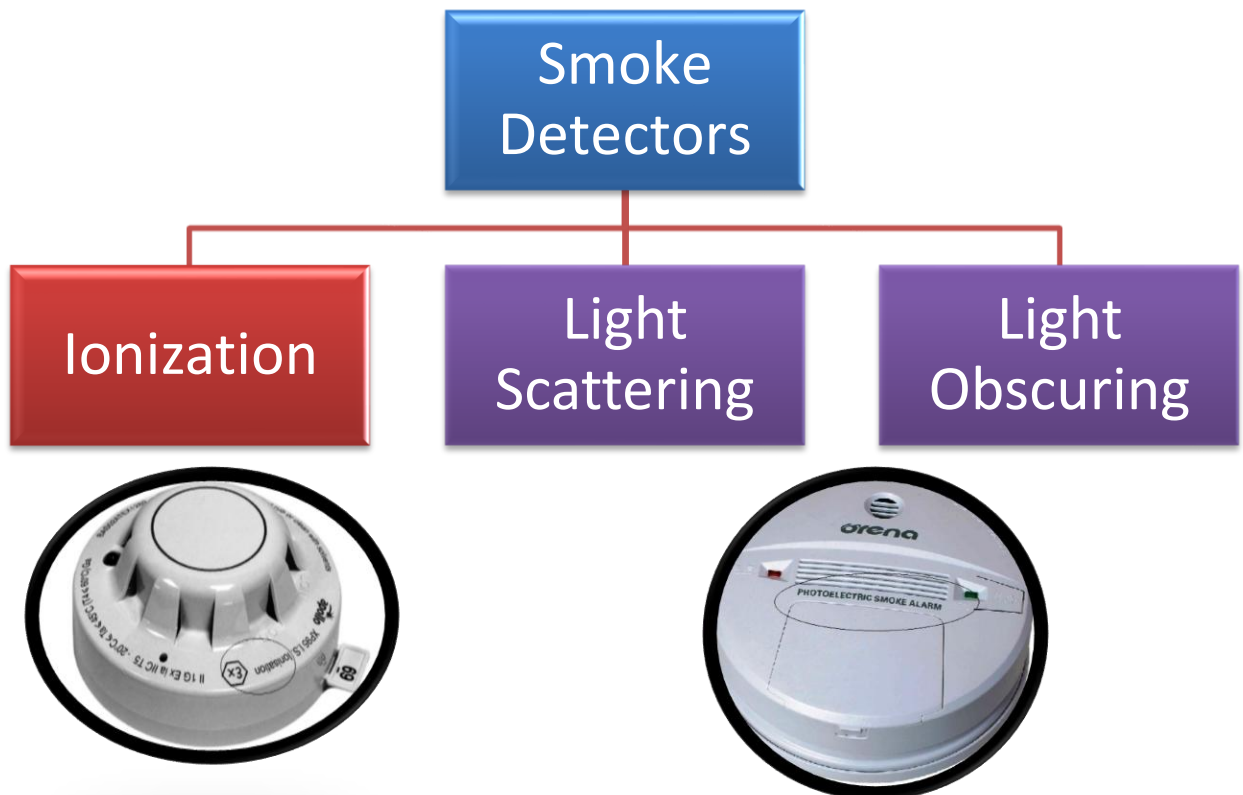
SMOKE SENSORS

Fireproofing plastic material
10 Year Lithium Battery
Long Lasting Alarm Horn
Switch
Photoelectric
Sensor
Intelligent Chipset

- Smoke detectors are housed in plastic enclosures,
- They are typically shaped like a disk or square about 150 millimetres (6 in) in diameter and 25 millimetres (1 in) thick, but shape and size vary.

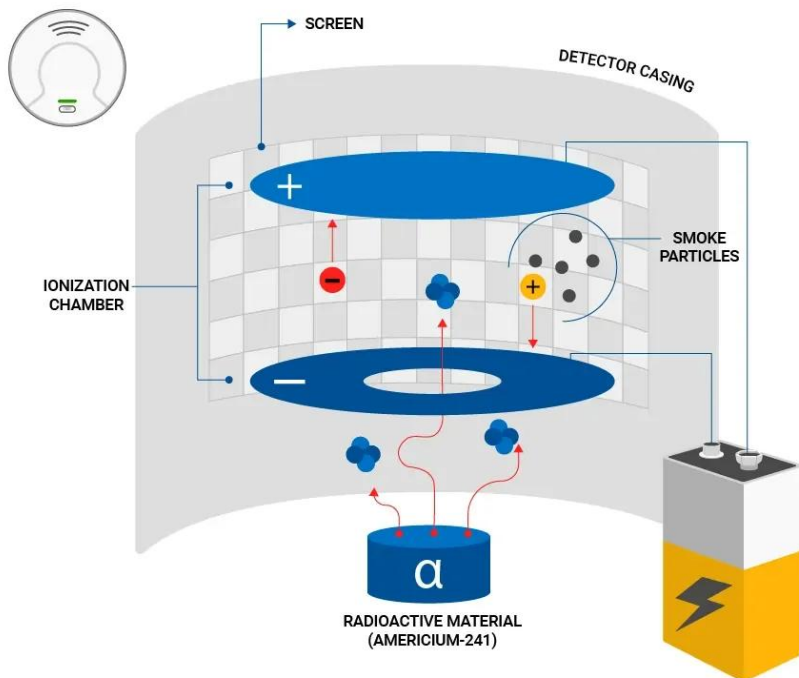There are three basic types of smoke detectors including:

Smoke Detectors

Ionization

Light Scattering

Light Obscuring

SMOKE SENSORS

Ionization Smoke Detector

This detector contains two chambers.
1) Used as a reference to compensate for changes in ambient temperature, humidity or pressure.
2) contains a radioactive source, usually alpha particle, which ionizes the air passing through the chamber where a current flows between two electrodes.
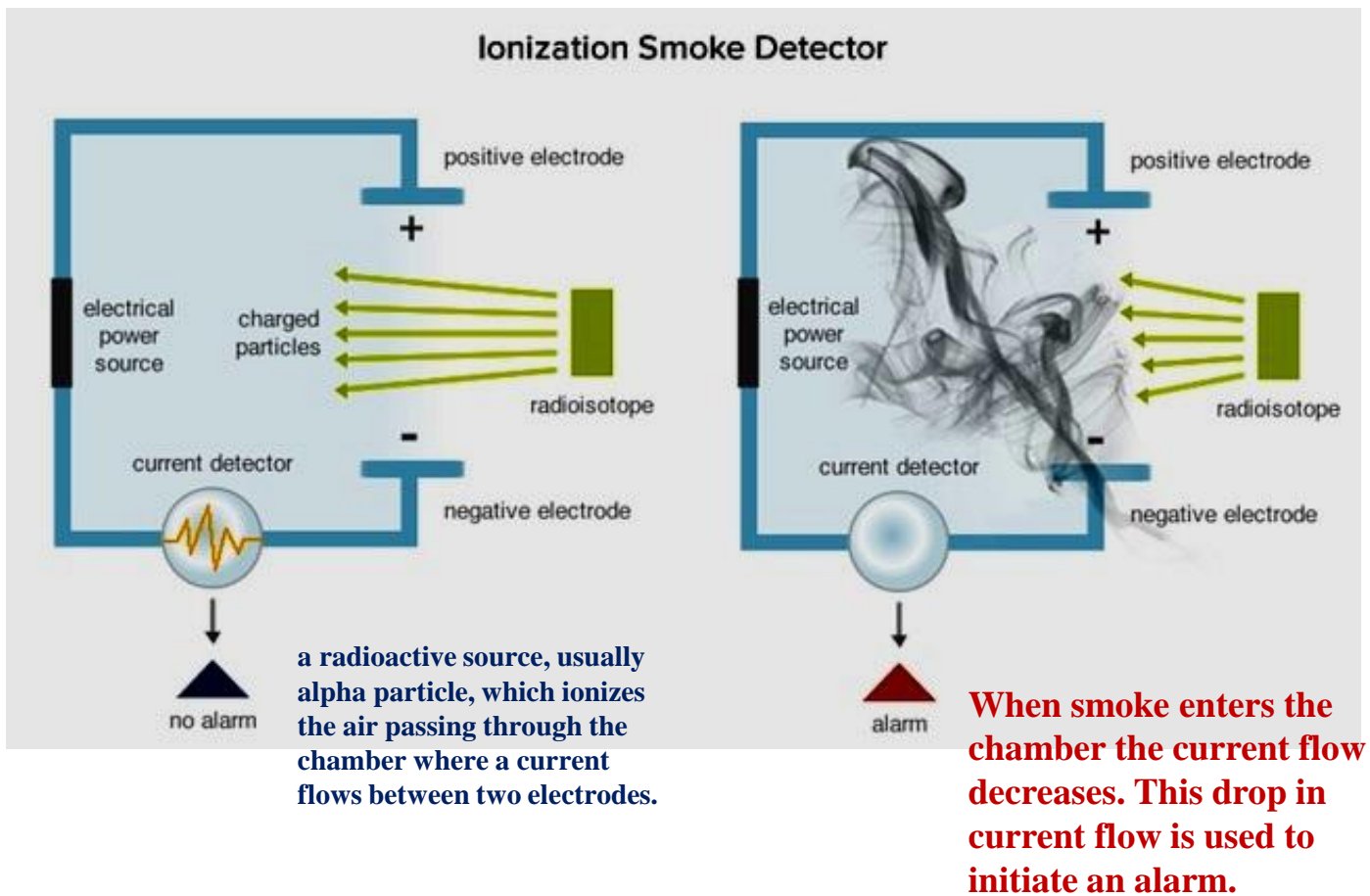

When smoke enters the chamber the current flow decreases. This drop in current flow is used to initiate an alarm.

•Working:

A radioactive source, usually alpha particle, which ionizes the air passing through the chamber where a current flows between two electrodes.

•A small amount of radioactive material (usually Americium-241) ionizes air, allowing current to flow.
•When smoke enters the chamber the current flow decreases. This drop in current flow is used to initiate an alarm.

•When smoke enters, it disrupts the flow of ions, reducing current—this triggers the alarm

•Strength: Highly sensitive to **fast-flaming fires**.
•Limitation: Less effective at detecting **slow, smoldering fires**.

SMOKE SENSORS

Ionization Smoke Detector

positive electrode

+

electrical power source

charged particles

radioisotope

−

current detector

negative electrode

no alarm

a radioactive source, usually alpha particle, which ionizes the air passing through the chamber where a current flows between two electrodes.

positive electrode

+

electrical power source

radioisotope

−

current detector

negative electrode

alarm

When smoke enters the chamber the current flow decreases. This drop in current flow is used to initiate an alarm.

Ionization Smoke Detectors:

Advantages :
1. **Detects invisible products of combustion. It can detect fires that are in the incipient stage or detect other aerosol-type smoke products.**
2. **Quick acting -- Provides for earlier detection than other types of smoke detectors or thermal detectors.**

Disadvantages :
1. **May provide false detection if used where volatile solvents, conductive material dusts, or high humidity are present .**
2. **Detects the presence of smoke only, not toxicity .**
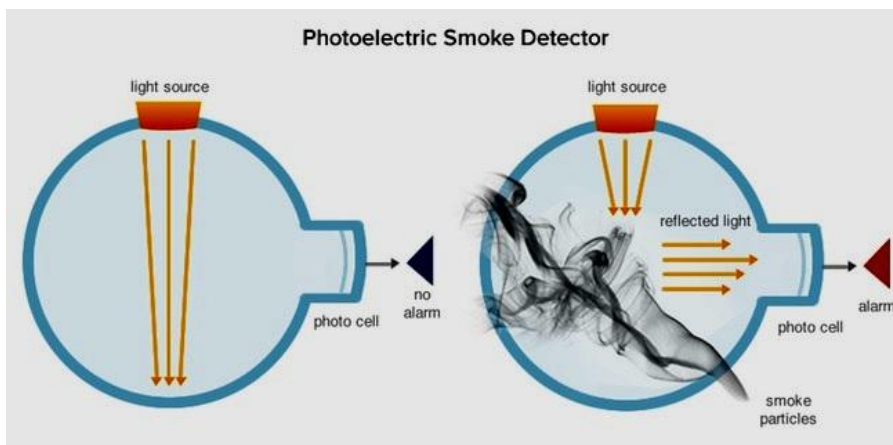3. **Has a potential for high false alarm rate.**

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Photoelectric Smoke Detector

1. **The photoelectric type detector utilizes light as a detection mechanism.**
2. **A photoelectric, or optical, smoke detector contains a source of infrared, visible, or ultraviolet light, a lens, and a photoelectric receiver (typically a photodiode).**

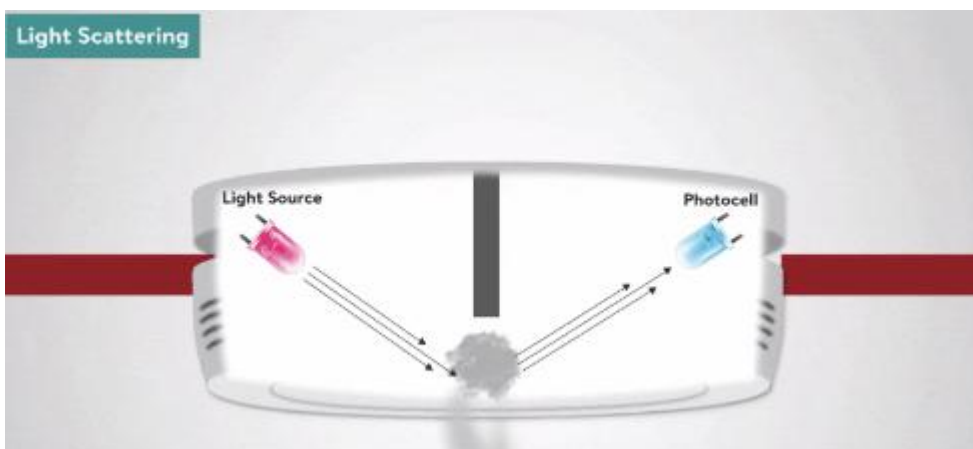*There are two types of photoelectric smoke detectors:*
►   **Light sensing (scattering)**
►   **Light obscuring (blocking)**

Photoelectric Smoke Detector

Light Scattering Smoke Detector

The light scattering smoke detector operates on the Tyndall effect; a photocell and light source are separated from each other by a darkened chamber such that the light source does not fall on the photocell.

The passage of smoke into the chamber causes the light from the source to be scattered and fall on the photocell. The photocell output is being used to initiate an alarm.
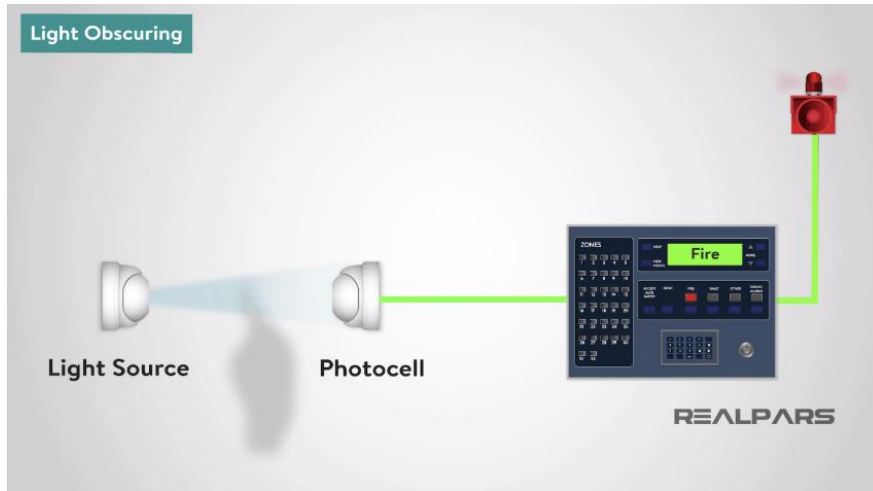

Light Scattering

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Light Obscuring Smoke Detector
In the Light obscuring smoke detector, smoke interferes with a light beam between a light source and photocell. The photocell measures the amount of light it receives.

The variation in photocell output, is being used to initiate an alarm.
This type of fire detection equipment can be used to protect large areas with the light source and photocell positioned some distance apart.

Applications
- 🏠 **Residential buildings**: Early warning systems in homes and apartments.
- 🏢 **Commercial spaces**: Offices, malls, restaurants.
- 🏭 **Industrial facilities**: Warehouses, factories, and power plants.
- 🚗 **Automotive**: Smoke detectors in electric vehicles or battery systems.
- 💻 **Data centers**: High-sensitivity detectors to prevent electronics damage.
- ✈️ **Aerospace**: Cabin safety, engine monitoring.

Advantages :
1. **Sensitive to visual particles of smoke**
2. **Detects smoldering low heat fires**
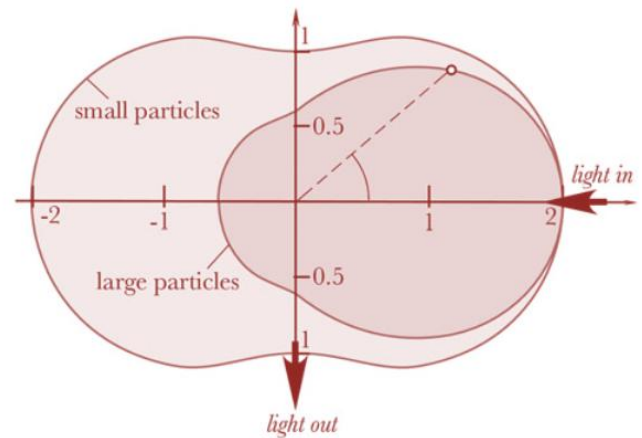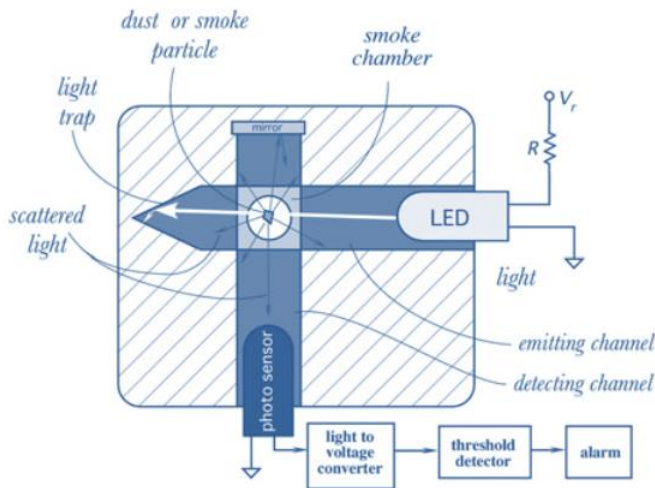3. **Provide early warning**

Disadvantages :
1. **Early contamination by dust causing reduced sensitivity**
2. **Detects presence of smoke, not toxicity**
3. **Must be cleaned on a regular basis**
4. **Has a potential for high false alarm rate**

SMOKE SENSORS

There are also few more types of smoke sensors

4. Optical Detector

5. Dual-Sensor Smoke Detectors
•**Combination** of ionization and photoelectric technologies.
•**Advantage**: Provides broad-spectrum detection—effective for both flaming and smoldering fires.

6. Aspirating Smoke Detectors (ASD)
•Continuously draw air through a network of pipes into a highly sensitive laser-based detection chamber.
•**Used in**: Cleanrooms, data centers, high-value infrastructure.
•**Very high sensitivity**, capable of detecting minute amounts of smoke.

7. CO-based or Gas-Sensing Smoke Detectors
•Detect **carbon monoxide (CO)** levels produced by fire or combustion.
•Often combined with other sensors for **multi-parameter fire detection**.