

THERMAL DETECTORS OF INFRA RED SPECTROPHOTOMETER

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PRINCIPLE:

- Thermal detectors contain a small active element on which radiation is focused.
- By blackening and insulating the element and by minimum the size of the element, temperature change and detector response is maximized.
- Temperature change is approximately inversely proportional to the exposed surface area of the element.
- As the intensity of the radiation increases the temperature change on the element of the detector increases.

TYPES OF THERMAL DETECTORS:

1. Thermocouples : Thermocouple
2. Thermistors : Pyroelectric detector
3. Pneumatic devices : Golay cell.

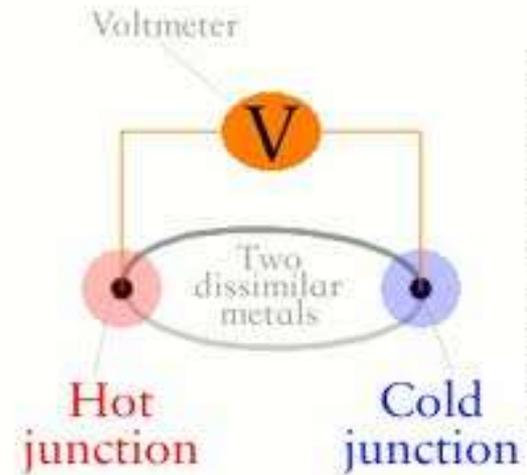
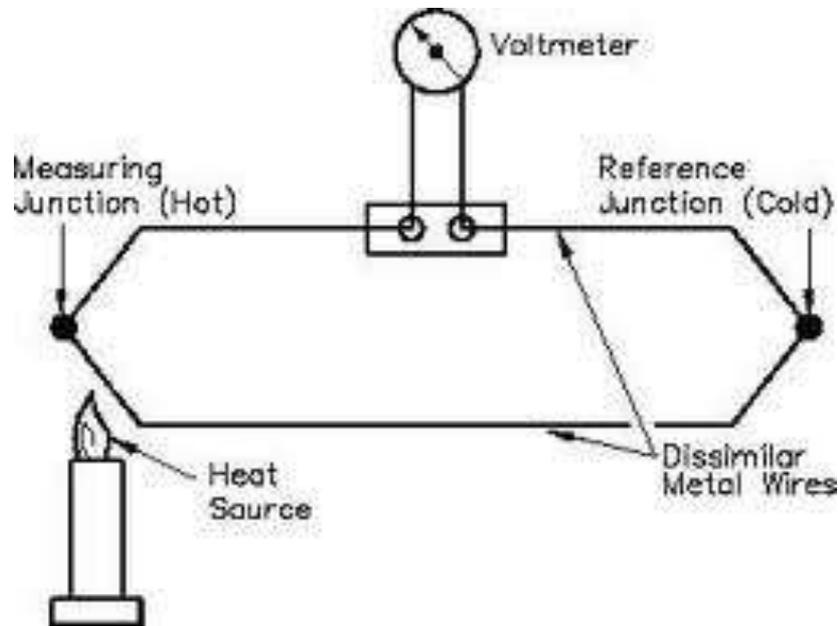
Merits:

- ✓ Used for wide wavelength range.
- ✓ Linearity in response is seen.

Demerits:

- ✗ Slow response time.
- ✗ lower sensitivity.

Thermocouple:



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THERMOCOUPLE:

- Two dissimilar metals like bismuth and antimony.
- Two ends are called Hot junction, Cold junction.
- The surface at the junction of the wires is coated with black metallic oxide.
- IR radiation falls on hot junction By heat source change in temperature at the junction between the metallic wires causes an electric potential to develop between the wires.
- The potential difference between the unjoined ends of the wires is amplified and measured.
- Cold junction is not exposed to IR
- Response time is 60 m/sec

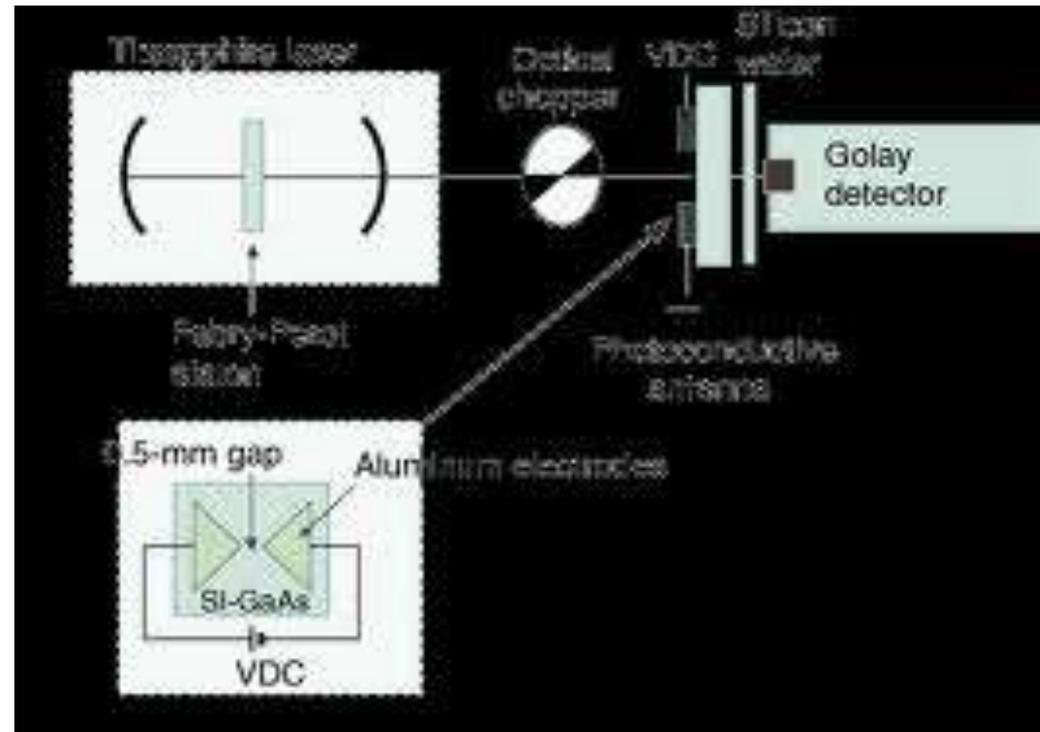
THERMISTORS:

- Thermistors are the devices that have an electric resistance that is higher temperature dependent.
- The materials used in thermistors are sintered oxide of Cobalt, Manganese , Nickel.
- A constant potential is applied across the thermistor and the difference in current flow between an illuminated thermistor and a non-illuminated thermistor is measured using a differential operational amplifier.
- As the temperature of mixture increases, its electrical resistance decreases.
- Response time is 80 m/sec.
- It should be operate at a frequency of less than 12Hz.

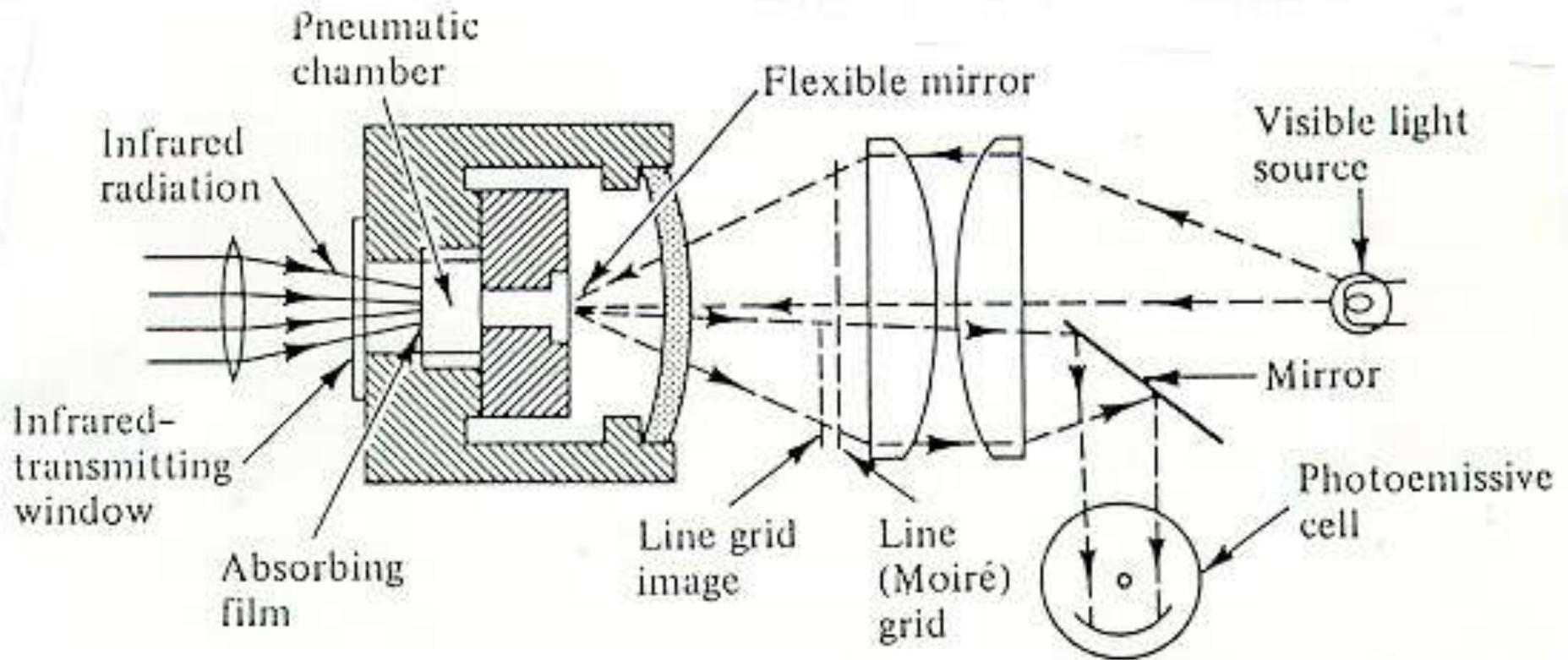
PYROELECTRIC DETECTORS:

- Pyroelectric detector contains a noncentrosymmetrical crystal, it exhibits an internal electric field along the polar axis.
- Pyroelectric effect depends on the rate of change of the detector temperature rather than on the temperature itself.
- These detectors operate with a much faster response time and makes the choice for Fourier Transform Spectrometers where the response is essential.
- Materials used in pyroelectric detectors
 - i. Triglycine sulfate(TGS)
 - ii. Deuterated triglycine sulfate(DTGS)
 - iii. Lithium niobate(LiNbO₃)
 - iv. Lithium tantalate(LiTaO₃).

Golay cell:



GOLAY CELL



GOLAY CELL:

- ❖ Golay cell consists of a small metal cylindrical closed by a rigid blackened metal plate.
- ❖ Pneumatic chamber is filled with xenon gas.
- ❖ At one end of cylinder a flexible silvered diaphragm and at the other end Infra red transmitting window is present.
- ❖ When infra red radiation is passed through infrared transmitting window the blackened plate absorbs the heat. By this heat the xenon gas causes expand
- ❖ The resulting pressure of gas will cause deformation of diaphragm. This motion of the diaphragm detects how much IR radiation falls on metal plate.
- ❖ Light is made to fall on diaphragm which reflects light on photocell
- ❖ Response time is 20 m/sec

References:

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Thankyou