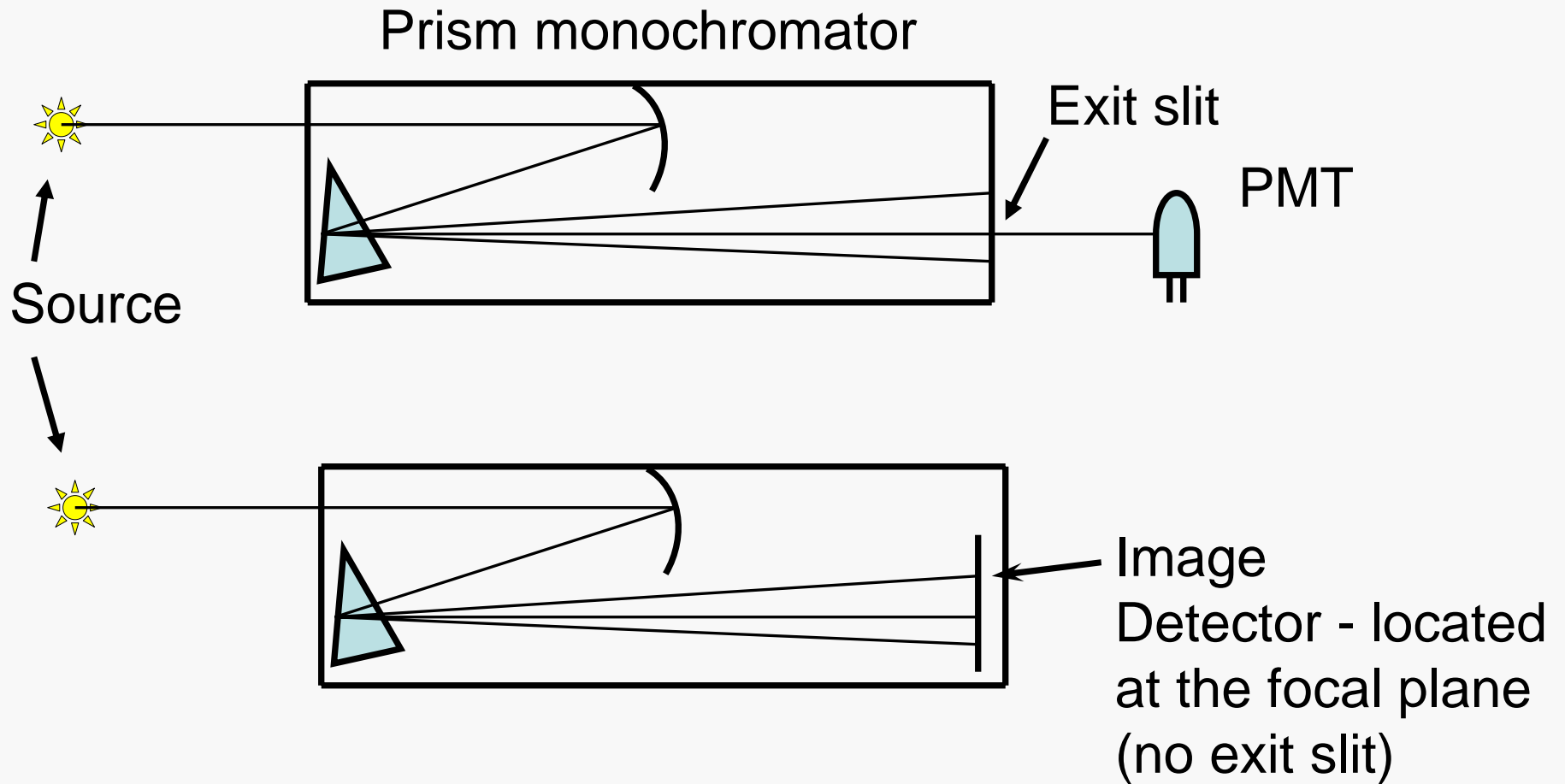
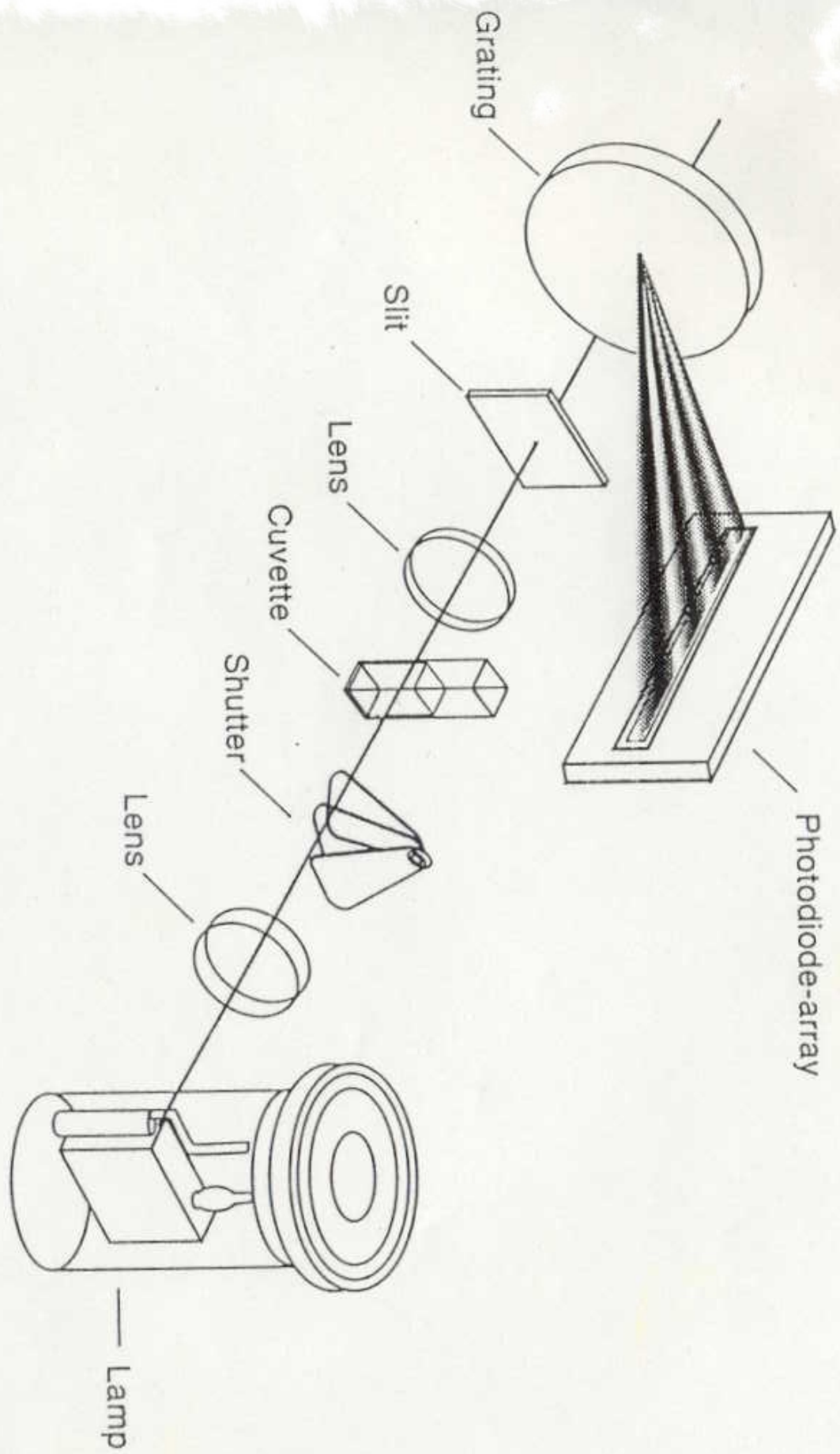


Image Detectors – powerful detectors used instead of PMTs to detect a complete spectrum or part of a spectrum





Common Image Detectors

- 1) Electron Image Intensifiers
- 2) Image Dissectors
- 3) Solid-State Imaging Systems
 - a) Vidicon tubes
 - b) Optical Multichannel Analyzers (OMAs)
 - c) Photo Diode Arrays (PDAs)
- 4) Charge Coupled Devices (CCDs)

These are often used with intensifiers –
device to increase sensitivity

Photodiodes, Linear Diode Array & Two Dimensional Arrays



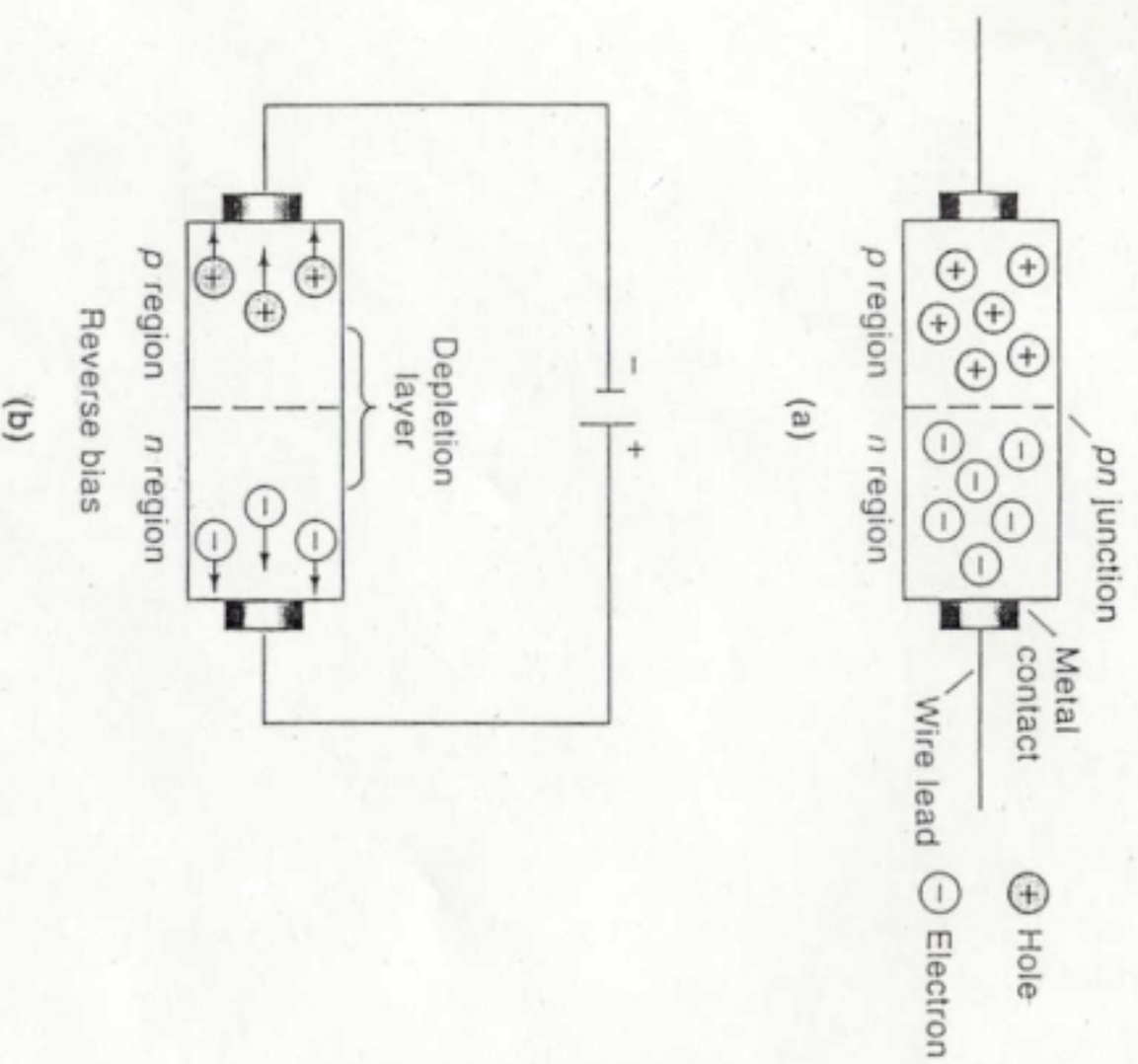
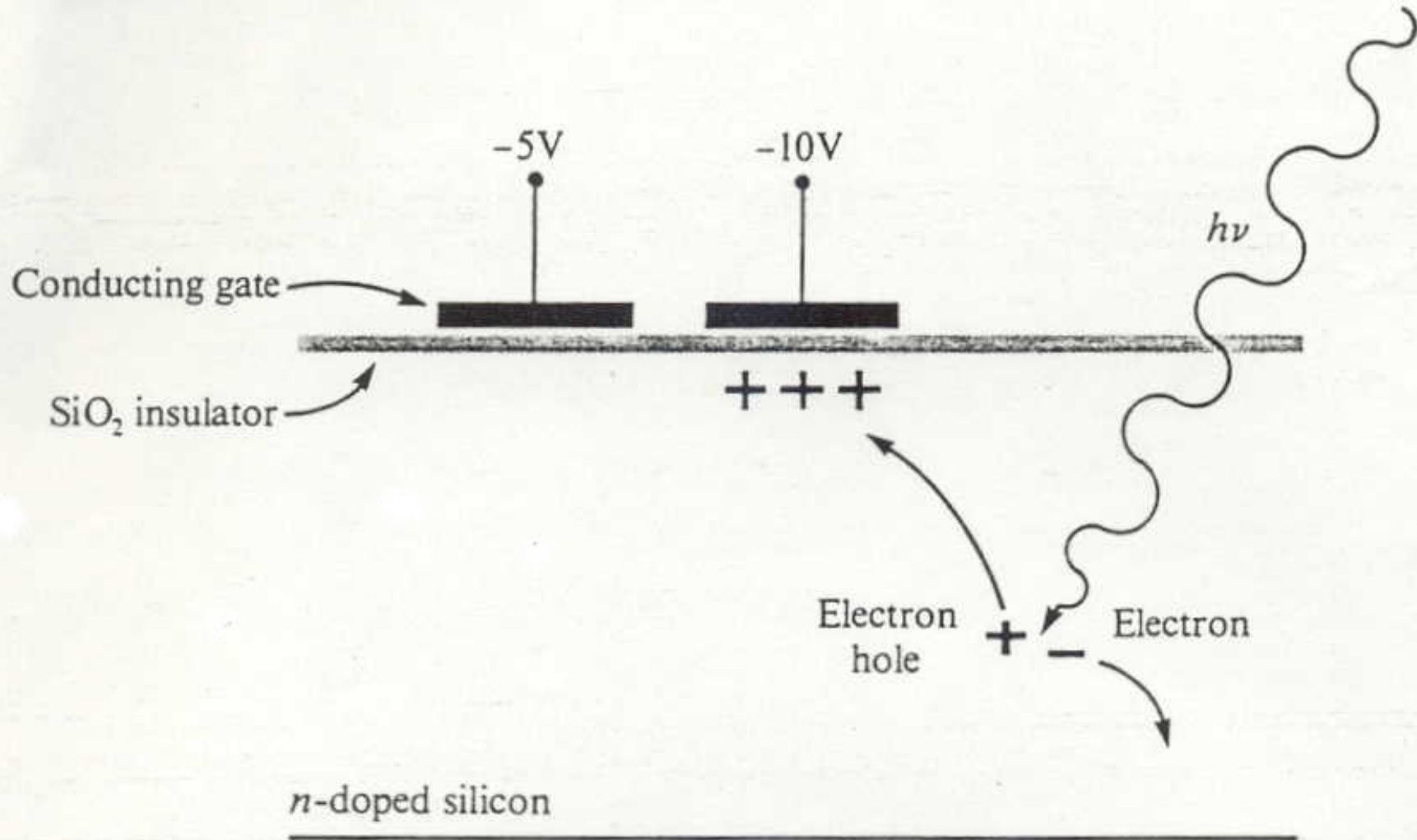
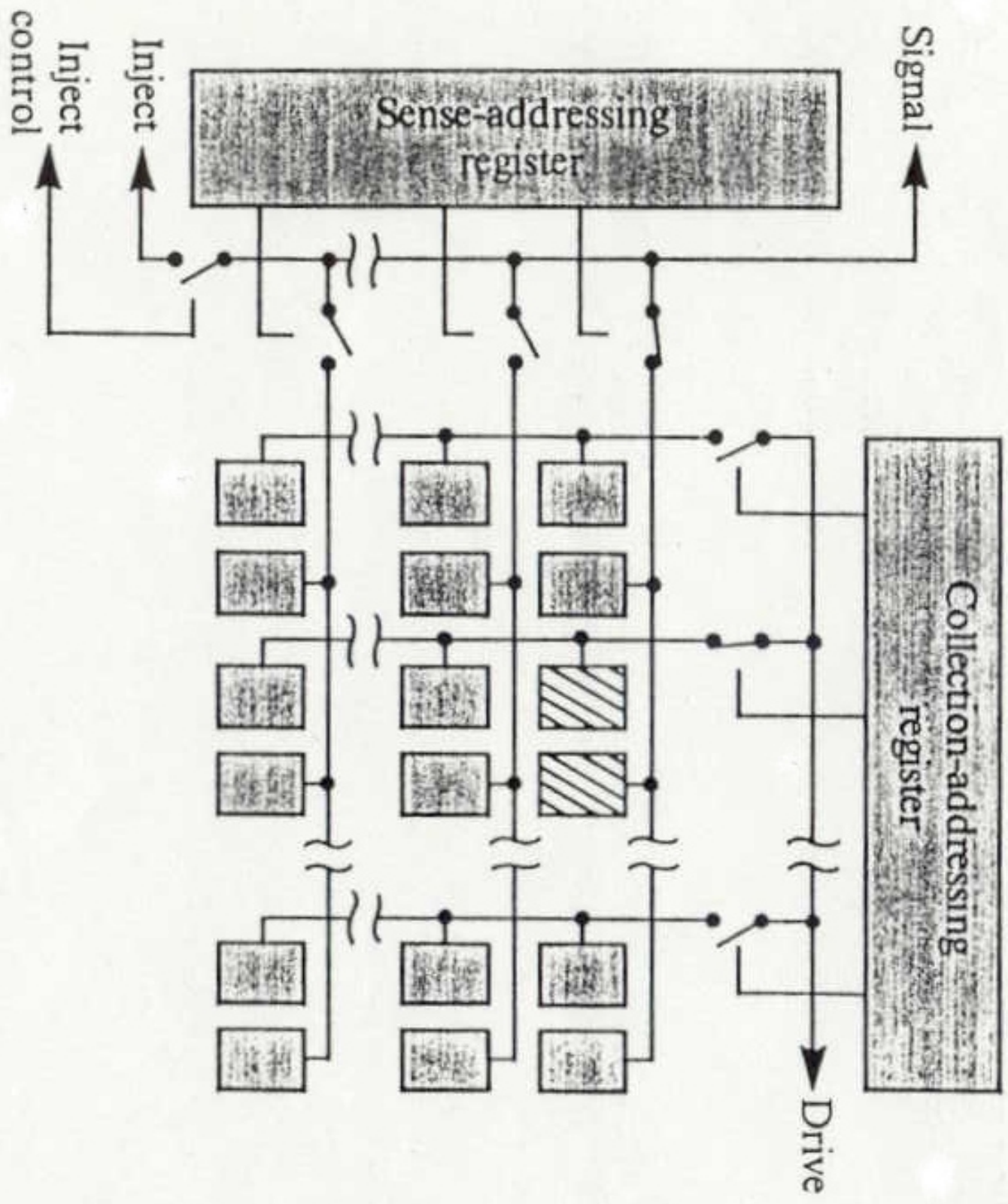


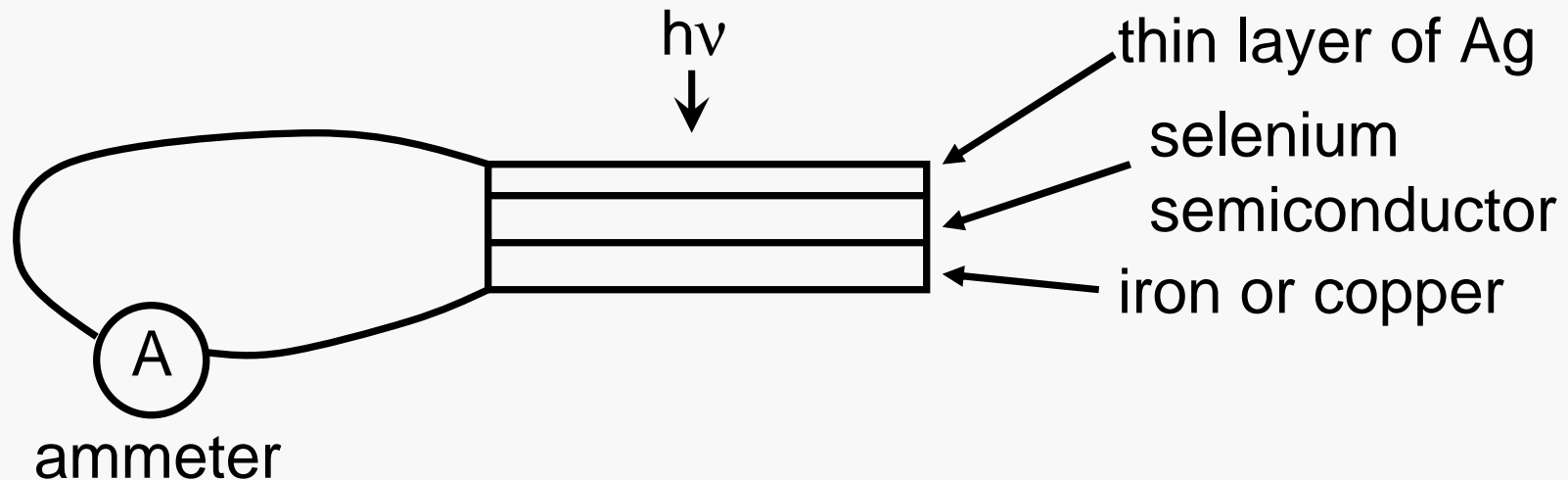
FIGURE 6-24 (a) Schematic of a silicon diode.
 (b) Formation of depletion layer, which prevents flow of electricity under reverse bias.

Charge Coupled Device (CCD)





Photovoltaic Cell



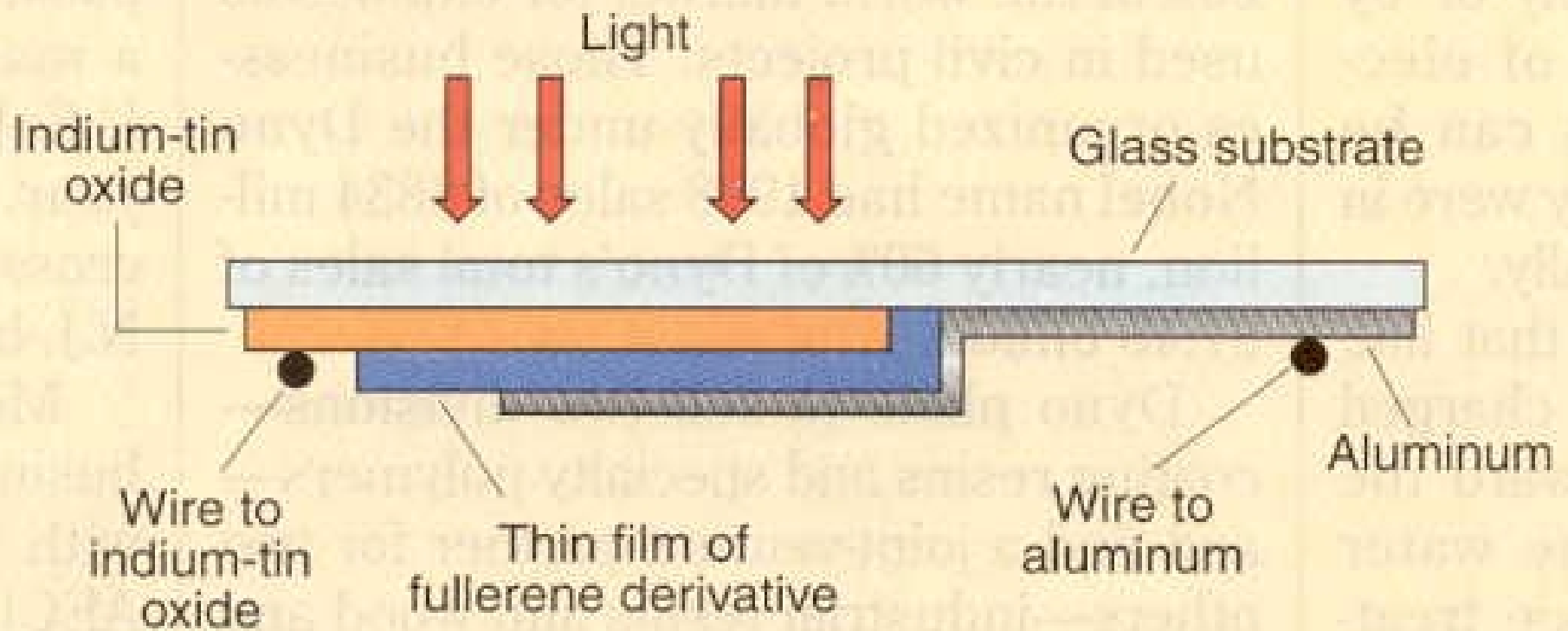
Light excites electrons in Se at Se-Ag interface into “conduction band” and to metal conductor → current

Good only for high light levels

Subject to fatigue effects

Another example of a Photovoltaic cell

Photovoltaic device incorporates fullerene derivative



Photoconductive detector – semiconductor used with voltage applied across it

Photons → electrons promoted to conduction band → high conductivity (lower resistance)

PbS, PbSe, InSb good for 0.7 to 4.5 μm (near IR)

Ge activated with Cu, Au or Zn good from 2 to 15 μm – operated at ~ 5 °K

Considerably less sensitive than PMTs

Better than thermal detectors in IR

Photographic detection – place film at focal plane and expose (integrating detector)

Advantages:

- 1) good resolution
- 2) fairly sensitive
- 3) covers entire spectral region

Disadvantages:

- 1) very old technique
- 2) quantitatively very bad (can use densitometer)

Thermal Detectors for IR – in IR region photons have lower energies → necessary to resort to thermal detectors – radiation absorbed and temperature change is detected

Response time is limited by rate of heat transfer → slow

Sensitivity is also much poorer

Three types of thermal detectors:

- 1) Thermocouples (most common) – junction between dissimilar metals often covered with black substance to increase absorption

Voltage difference across junction is a function of temperature

Amplify signal and detect

Response time ~60 msec (i.e. slow)

Sensitivity is greater using a thermopile = a bundle of many thermocouples

2) Bolometer (thermistor) – resistance is a function of temperature

Different kinds → Ni or Pt metal or oxides like NiO, CoO or MnO

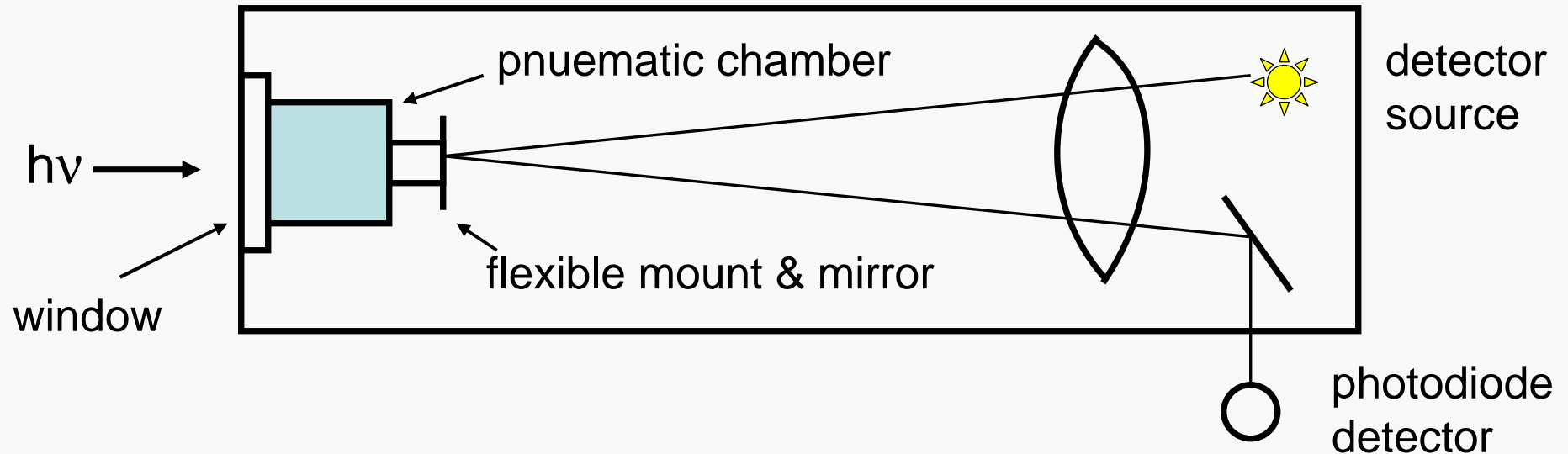
Many have black coating on side toward source and a heat shield around them

Typically connected to a bridge circuit

Johnson noise is important

Requires stable power supply

3) Golay Pneumatic Detector (best performance characteristics)

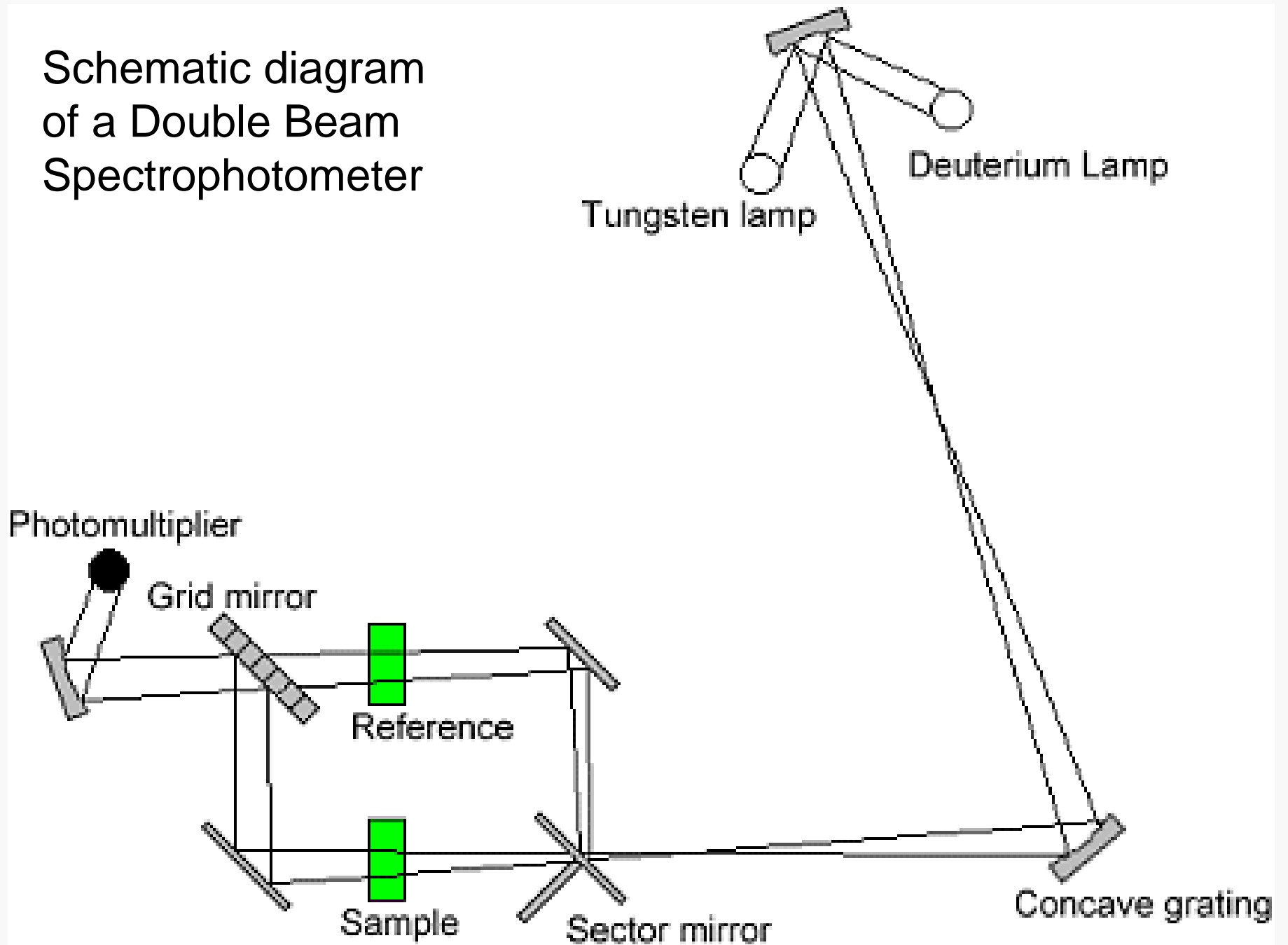


Heat from radiation \rightarrow gas expands \rightarrow
mirror position changes \rightarrow amount of light
reflected to photodiode changes

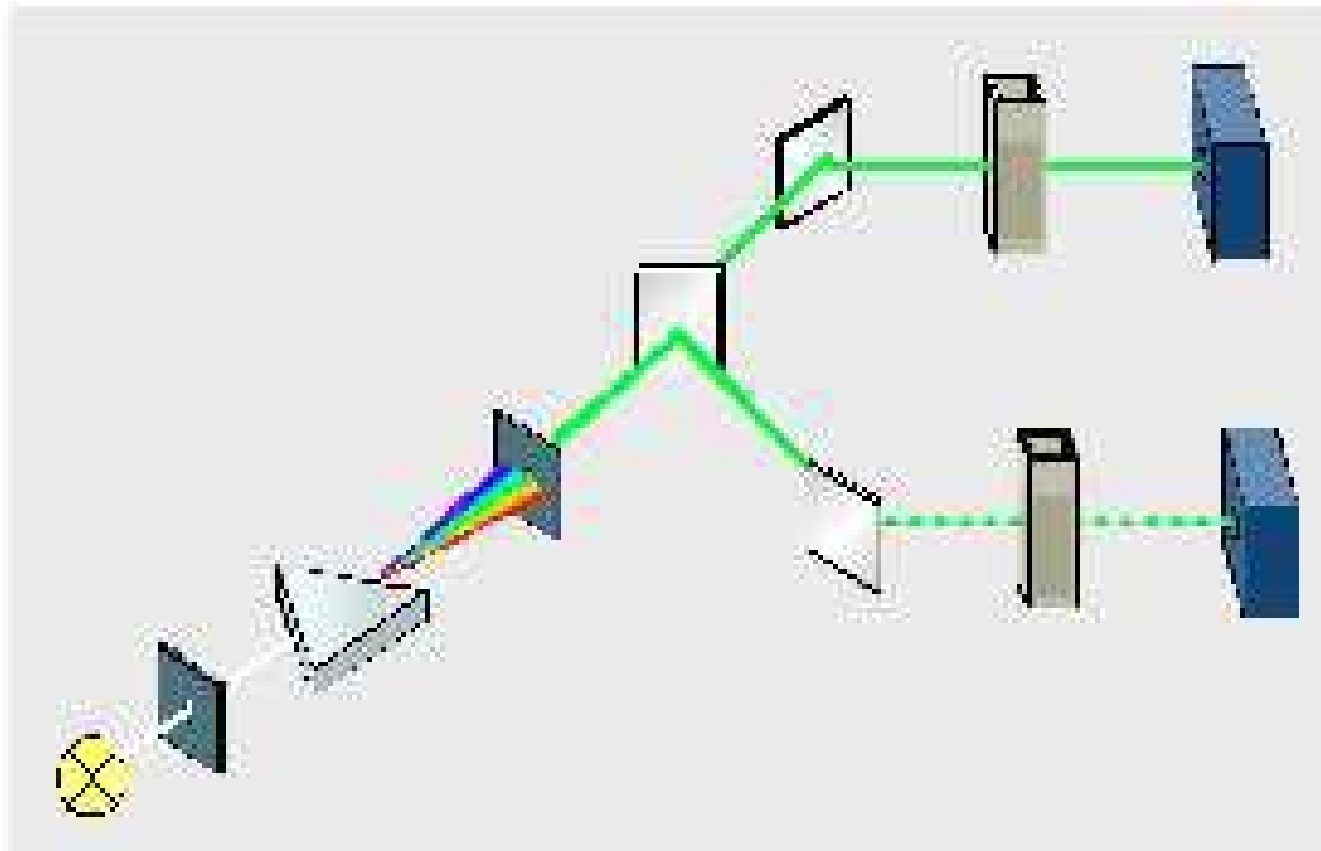
Best sensitivity

Response time ~ 4 msec \rightarrow heat transfer in gas
phase faster than in solid

Schematic diagram of a Double Beam Spectrophotometer



Schematic diagram of a Double Beam Spectrophotometer



Schematic diagram of a Single Beam Spectrophotometer

