SNS COLLEGE OF PHARMACY AND HEALTH SCIENCES

Affiliated To The Tamil Nadu Dr. MGR Medical University, Chennai

Approved by Pharmacy Council of India, New Delhi.

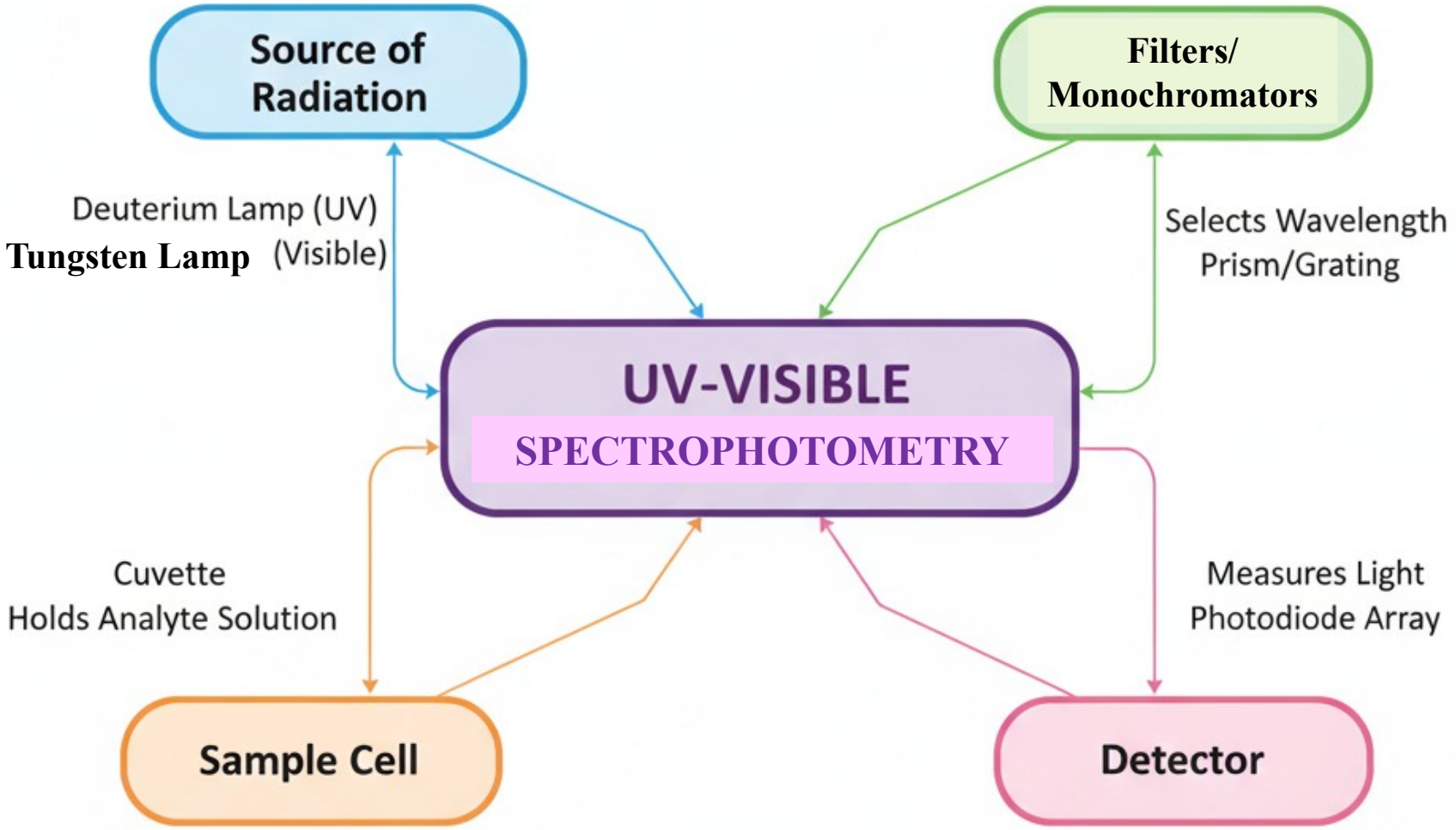
Coimbatore -641035

COURSE NAME: INSTRUMENTAL METHODS OF ANALYSIS (BP 701 T)

VII SEM/ IV YEAR

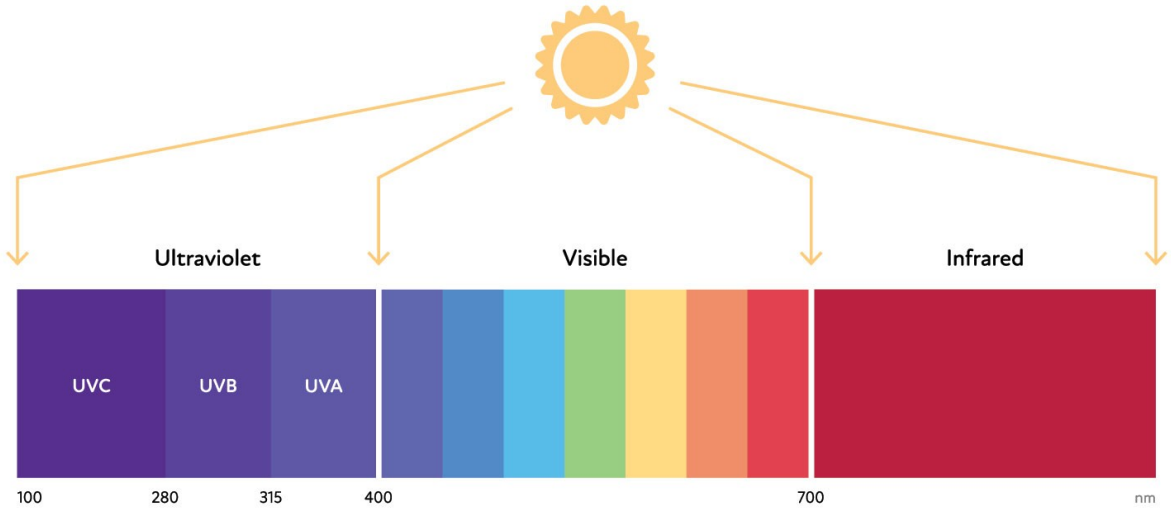
TOPIC 5: INSTRUMENTATION OF UV-VISIBLE SPECTROPHOTOMETRY

MINDMAP:


Source of Radiation
Deuterium Lamp (UV)
Tungsten Lamp (Visible)
Filters/ Monochromators
Selects Wavelength
Prism/Grating
UV-VISIBLE
SPECTROPHOTOMETRY
Cuvette
Holds Analyte Solution
Measures Light
Photodiode Array
Sample Cell
Detector

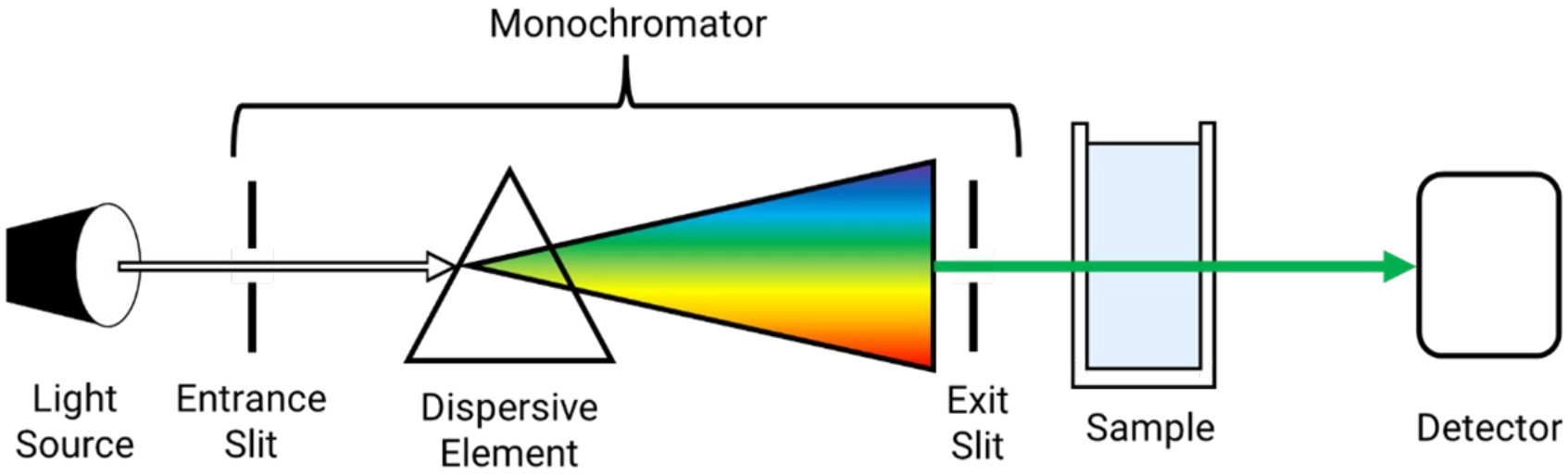
What is UV-Visible Spectroscopy?

Uses UV (200–380 nm) and Visible (380–780 nm) light.



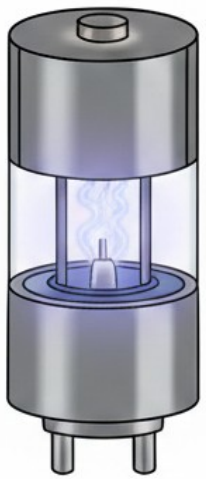
The Spectrum of Light

Principle of UV-Visible Spectrophotometry



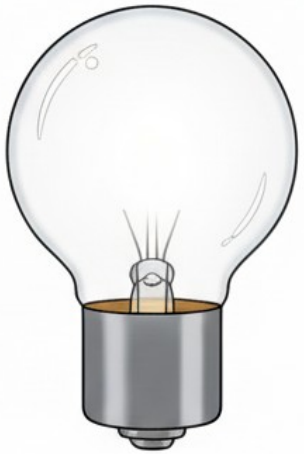
INSTRUMENTATION OF UV-VISIBLE SPECTROPHOTOMETRY

Sources of Light



DEUTERIUM UV LAMP
Use: 190-400 nm (UV)
Description:
Description: Continuous UV spectrum

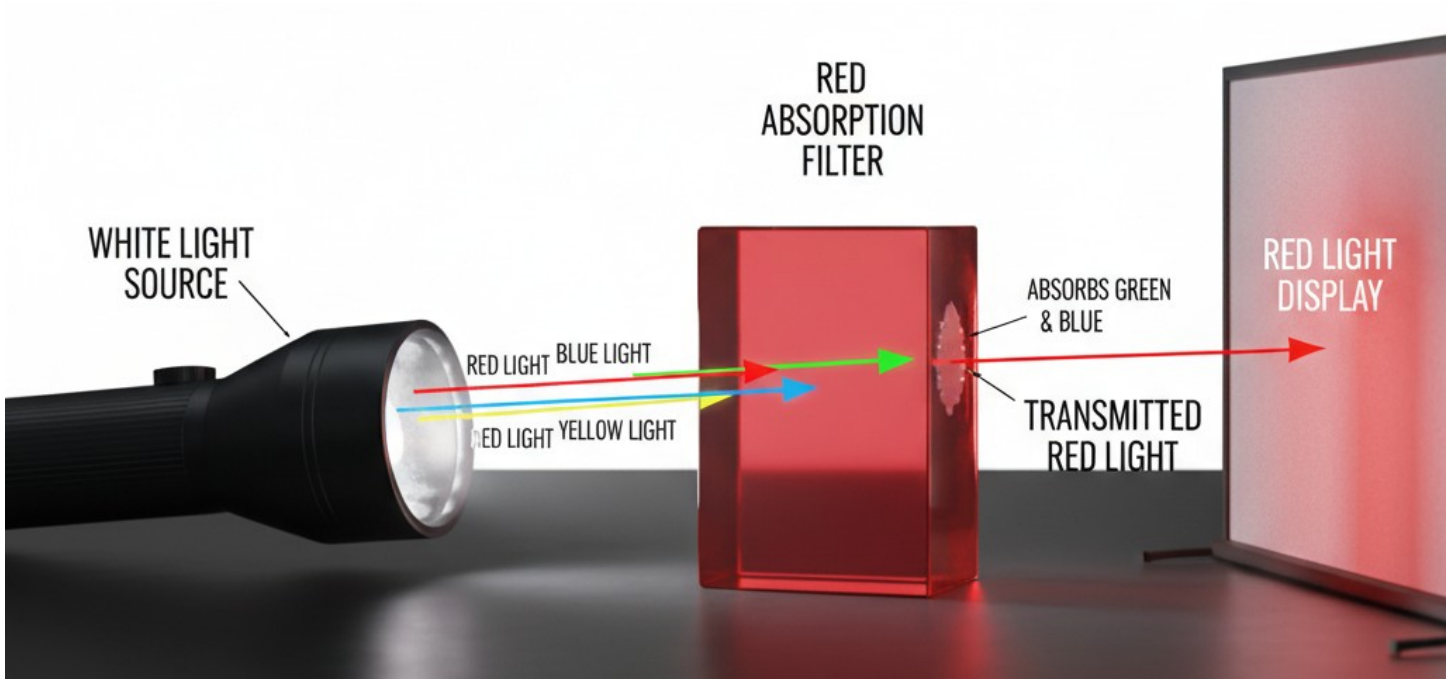
TUNGSTEN-HALOGEN VIS-NIR LAMP
Use: 320-1100 (Visible/NIR)
Stable, continuous visible spectrum



XENON ARC LAMP
Use: 190-100 nm (UV) (UV/Visible/NIR) spectrum:
Broad continuous spectrum

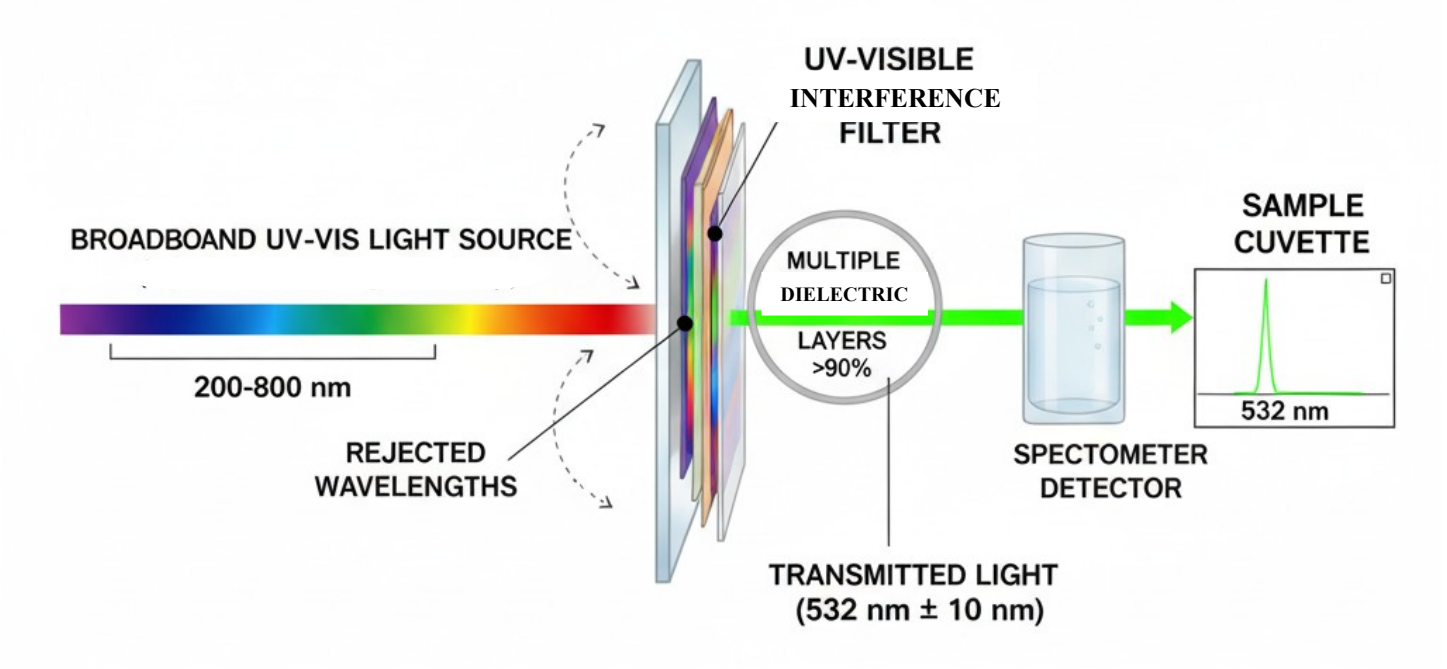
Filters

Absorption Filter



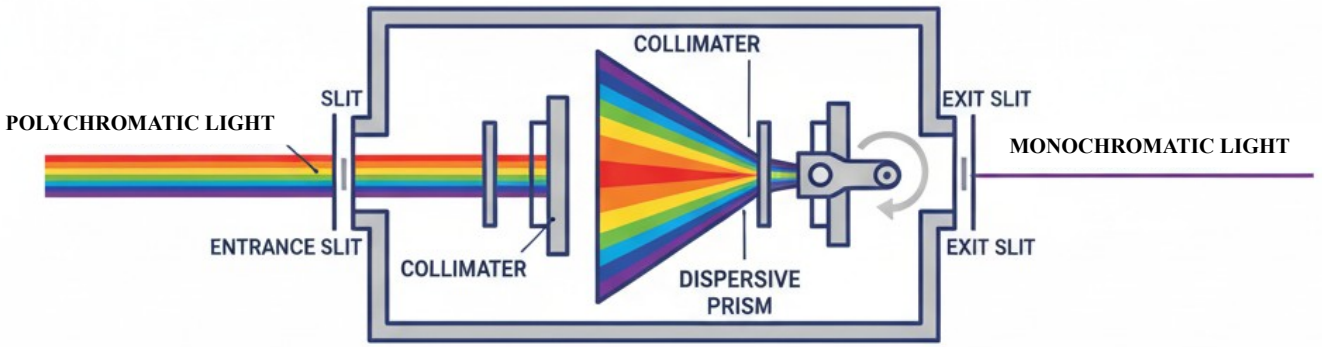
Filters

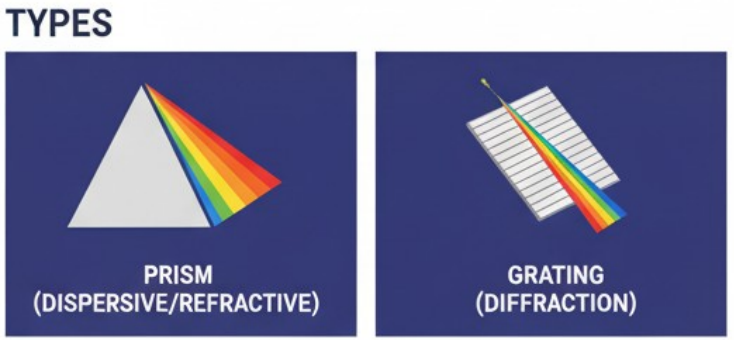
Interference Filter



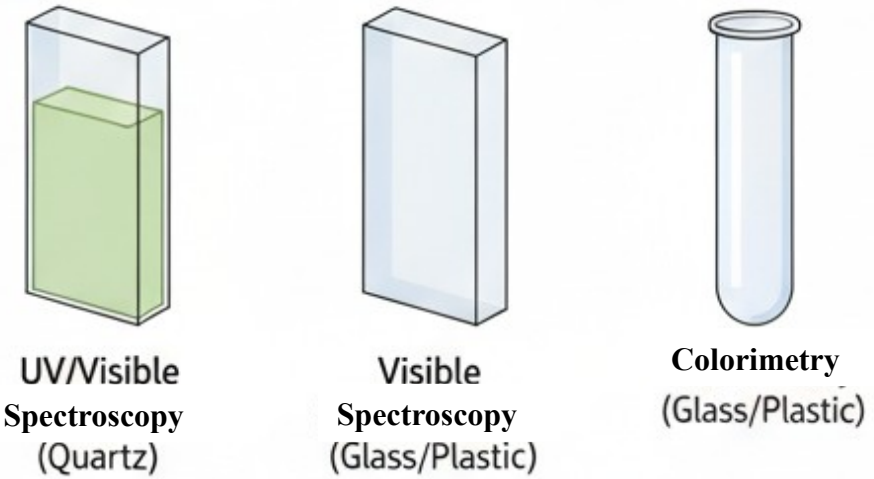
Monochromator

Converts polychromatic light to monochromatic light





Sample & Reference Cells

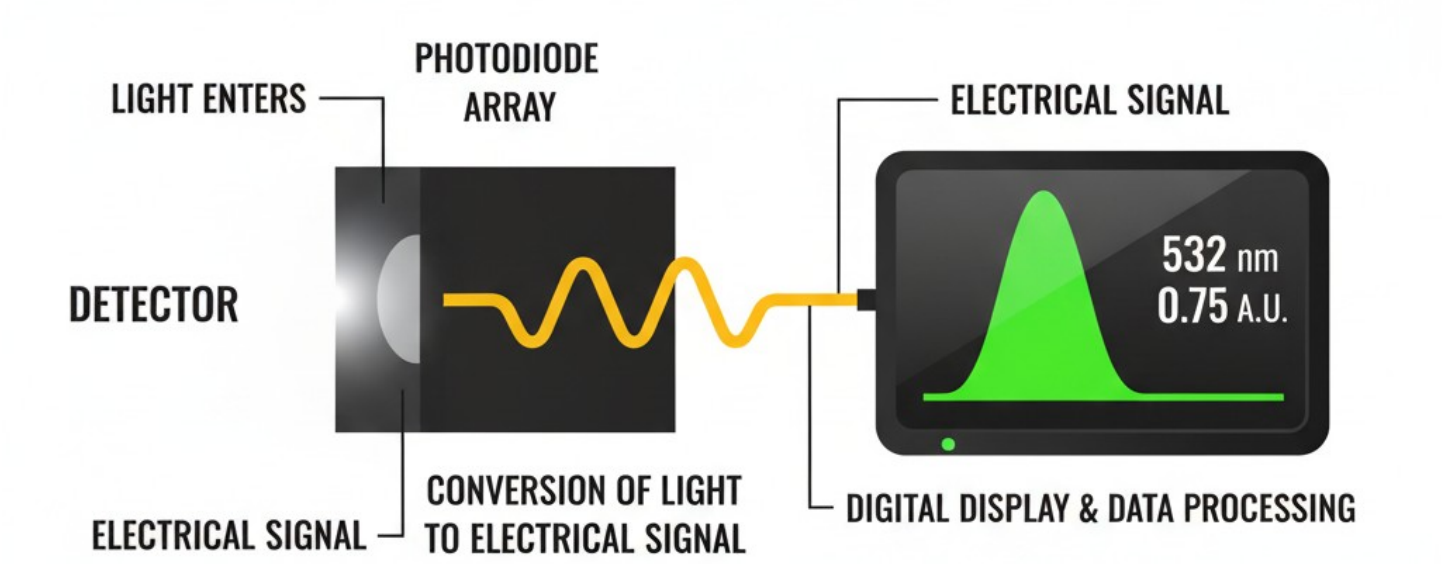


UV/Visible **Spectroscopy** (Quartz)

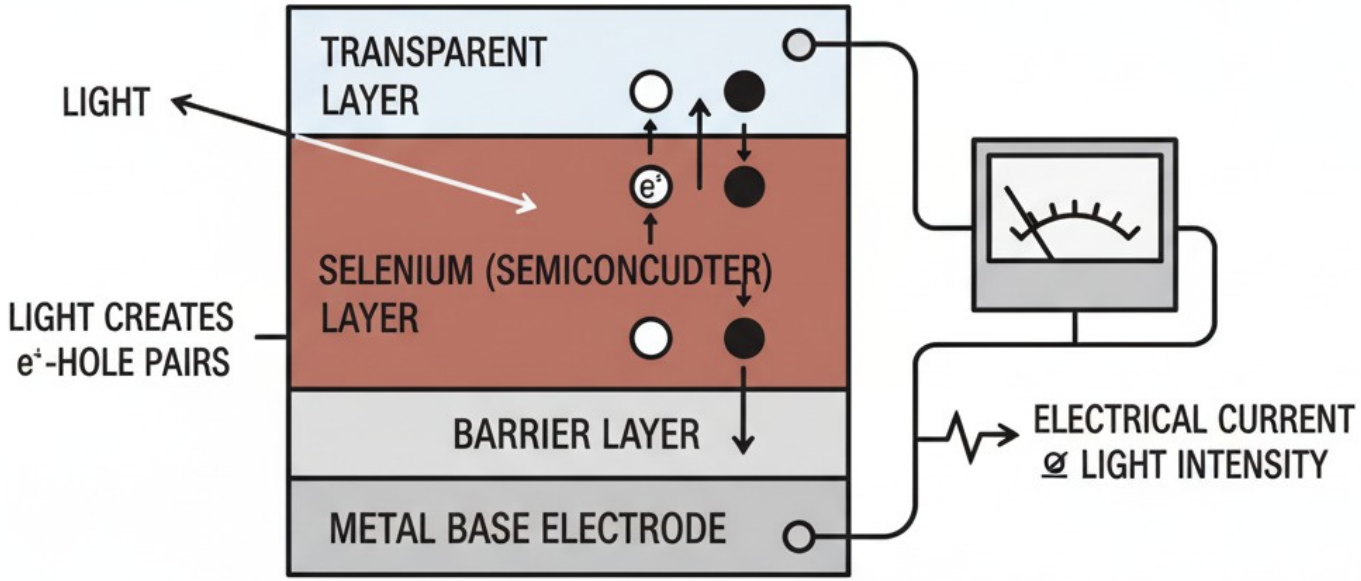
Visible **Spectroscopy** (Glass/Plastic)

Colorimetry (Glass/Plastic)

Detector


LIGHT ENTERS
PHOTODIODE ARRAY
DETECTOR
ELECTRICAL SIGNAL
CONVERSION OF LIGHT TO ELECTRICAL SIGNAL
ELECTRICAL SIGNAL
532 nm
0.75 A.U.
DIGITAL DISPLAY & DATA PROCESSING

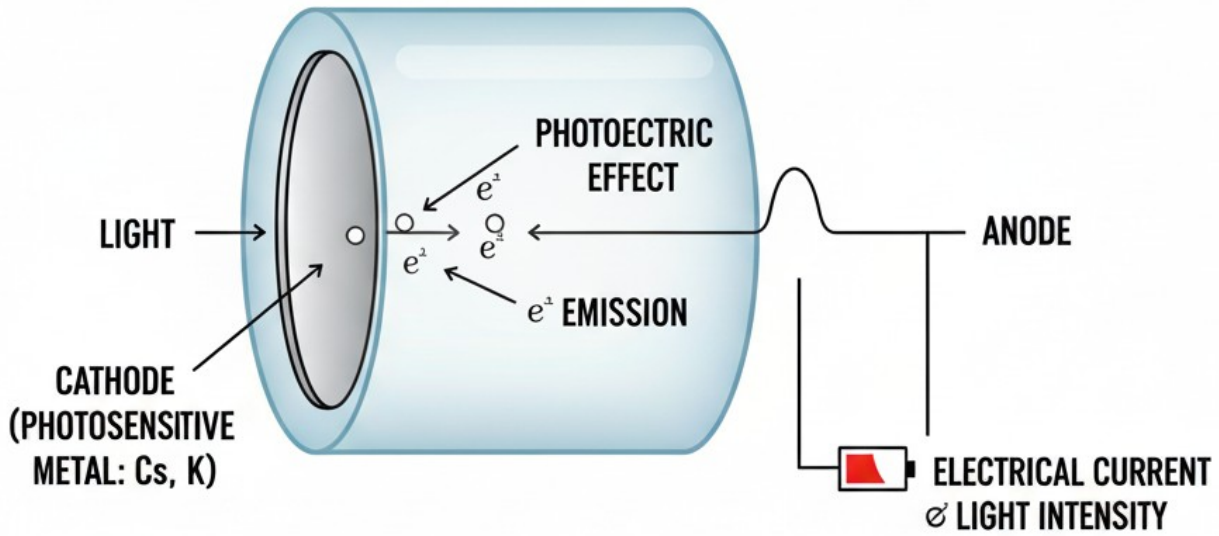
Barrier layer cell/ Photovoltaic cell



USE: COLORIMETERS (VISIBLE LIGHT ONLY)

NO EXTERNAL POWER REQUIRED

Photo emissive cell

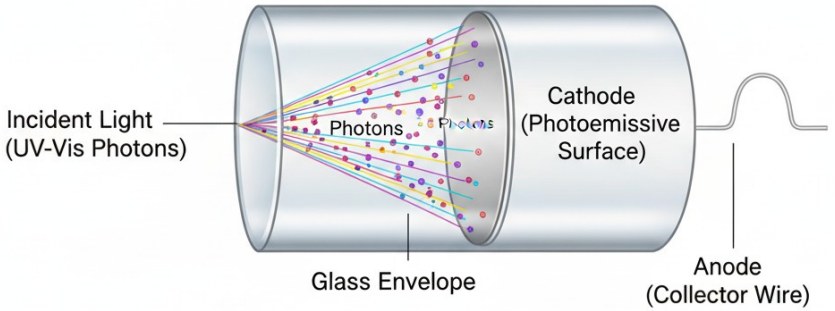


✓ USE: UV-VISIBLE SPECTOPHTROMETERS

✗ REQUIRES EXTERNAL POWER (VACUIM/GAS-FILLED)

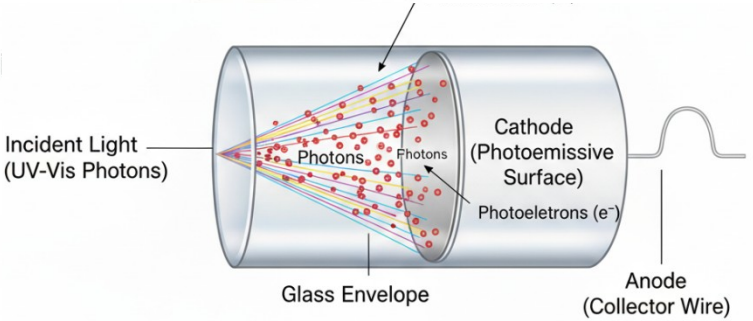
WORKING:

Step 1: Photon Incidence



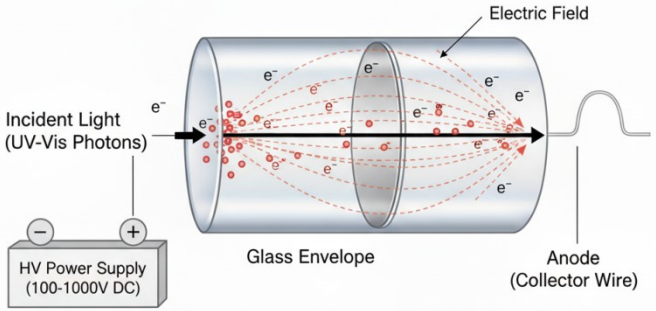
Action: Light strikes the cathode.

Step 2: Photoectric Effect



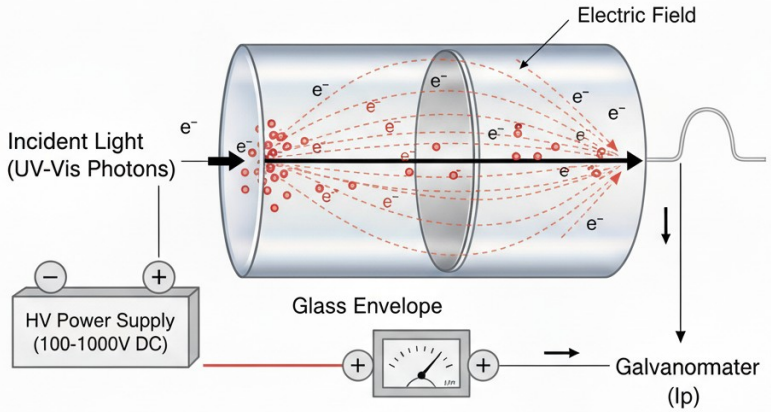
Action: Photons eject electrons from the cathode (Photoectric Effect)

Step 3: Electron Acceleration



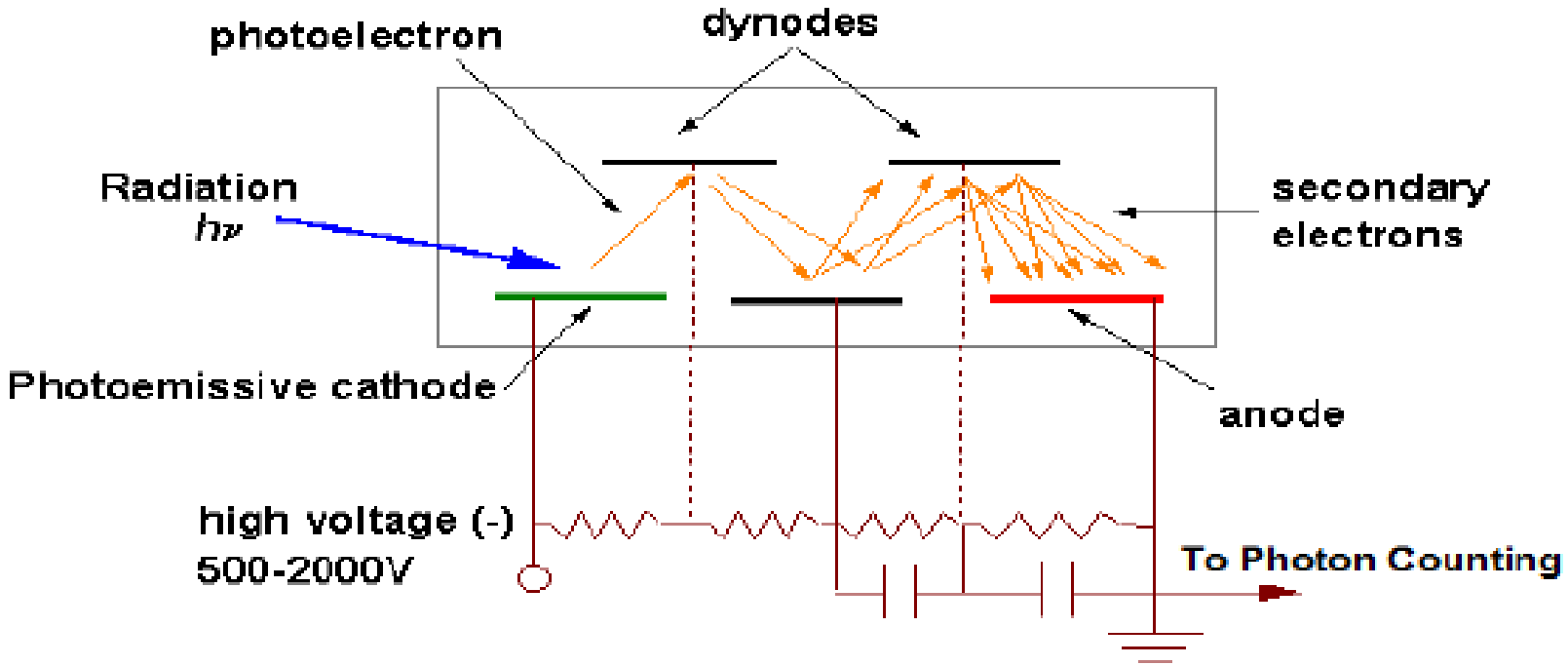
Action: High voltage accelerates electrons towards the anode

Step 4: Current Generation



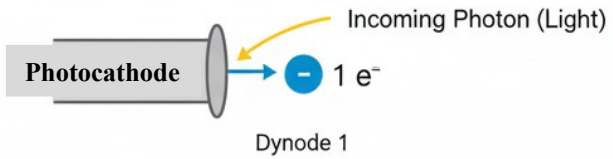
Result: Electron flow creates measurable current (Ip)

Photo multiplier tubes



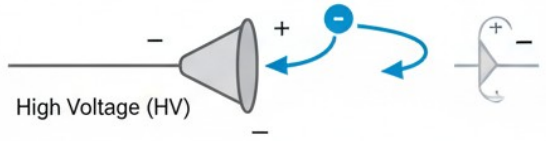
Working:

Step 1: Photon hits Photocathode



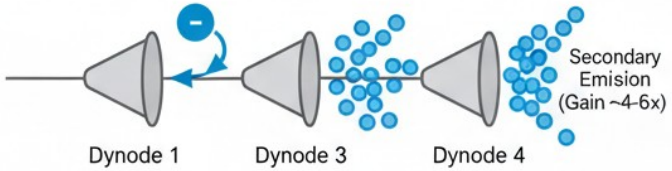
A single photon of light hits Photocathode, causing the emission of one electron (photoemission.

Step 2: Electron Accelerated



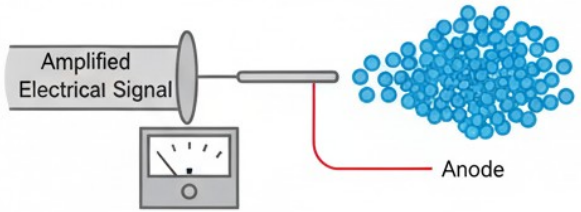
The electron is accelerated by high-voltage electric field towards the first Dynode.

Step 3: Electron cascade begins



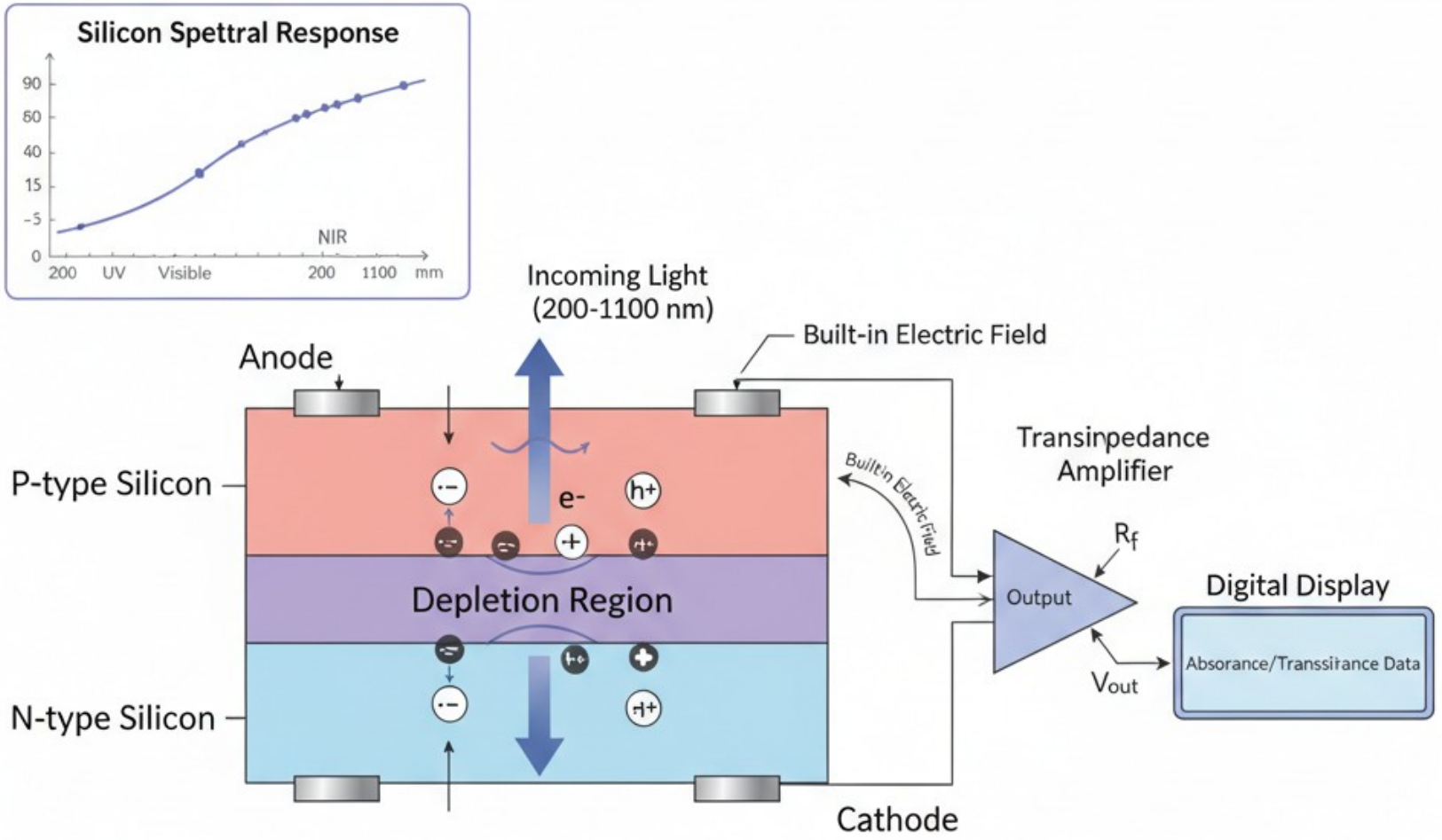
Upon impact, each electron causes new electrons of emitted of emitted (secondary emission).

Step 4: Singal amplified at anode



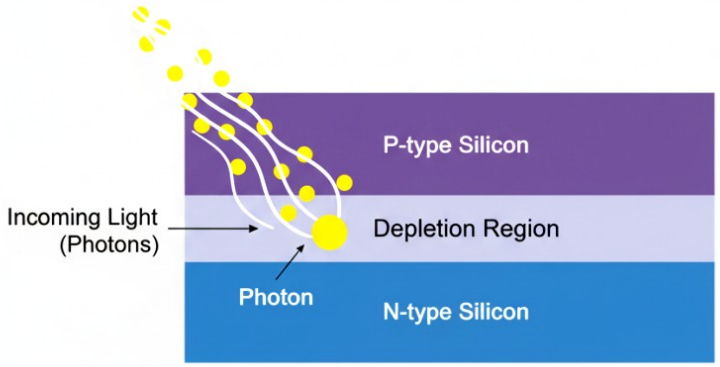
This multipication repeats across all 8-8-14 Dynodes, resulting, measurable electrical signal at Anode Total Gain 10^4 10^6–0^8).

Silicon Photodiode

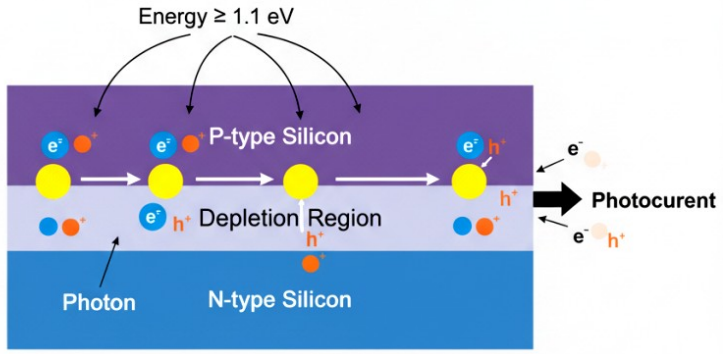


Working:

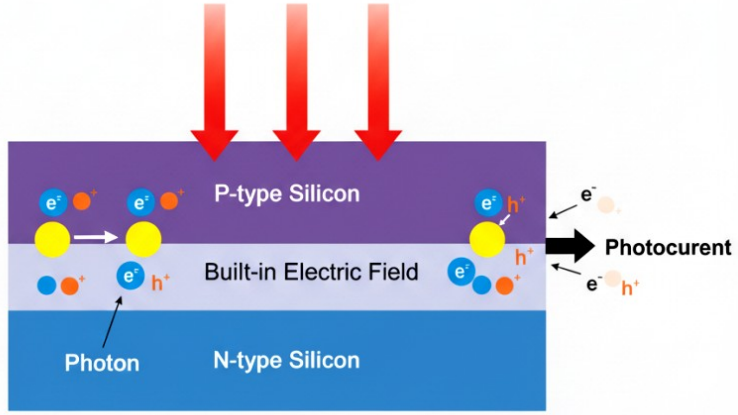
Step 1: Light Absorption



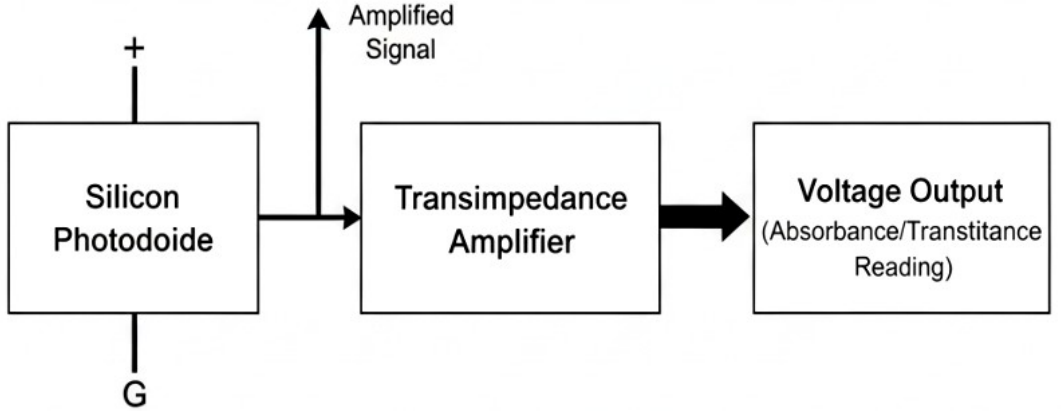
Step 2: Electron hole pair generation



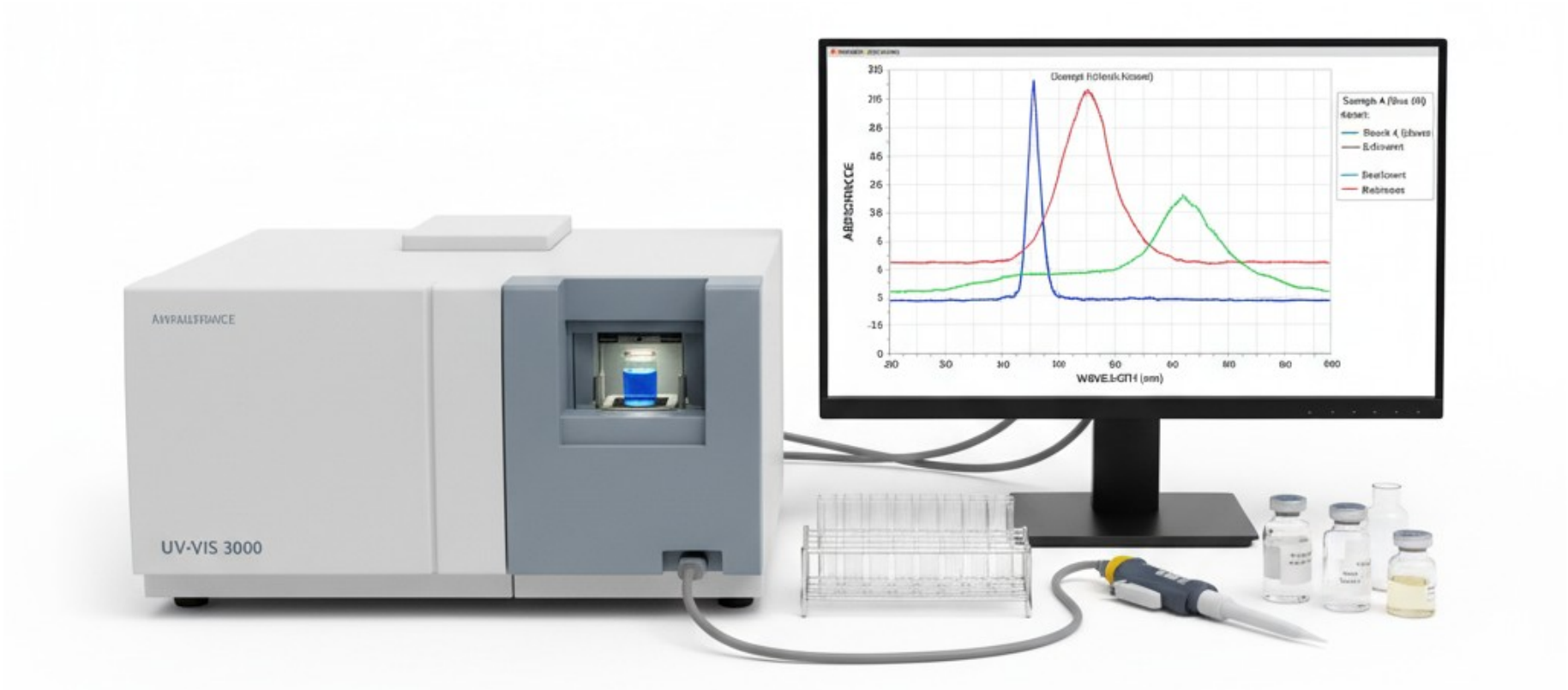
Step 3: Charge Separation & Current Flow



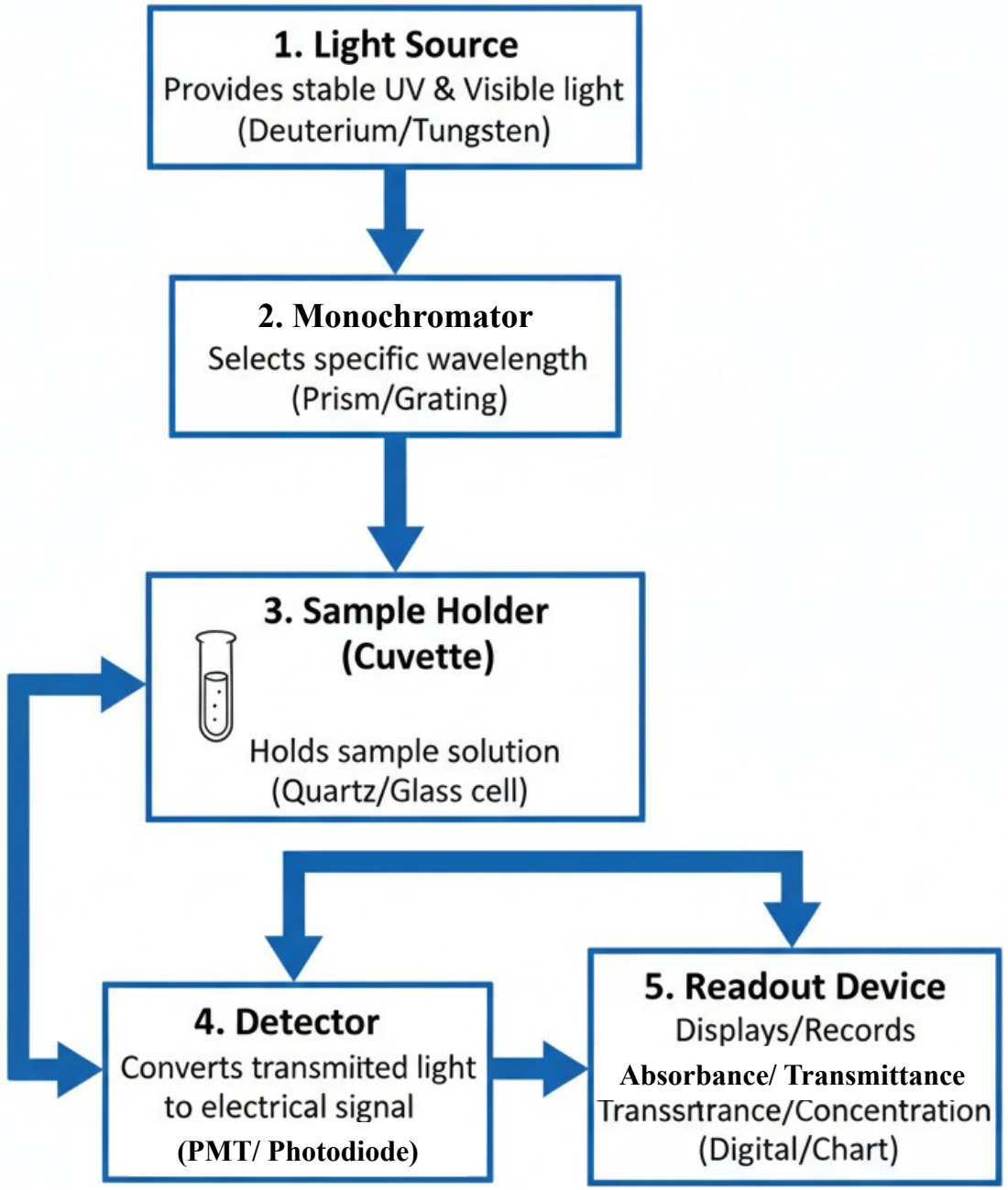
Step 4: Output & Measurement



Readout device



Summary:


1. Light Source
Provides stable UV & Visible light
(Deuterium/Tungsten)
2. Monochromator
Selects specific wavelength
(Prism/Grating)
3. Sample Holder
(Cuvette)
Holds sample solution
(Quartz/Glass cell)
4. Detector
Converts transmiited light
to electrical signal
(PMT/ Photodiode)
5. Readout Device
Displays/Records
Absorbance/ Transmittance
Transsrtrance/Concentration
(Digital/Chart)

Assessment

1. Which component of a UV-Vis spectrophotometer is responsible for separating light into different wavelengths?

Assessment

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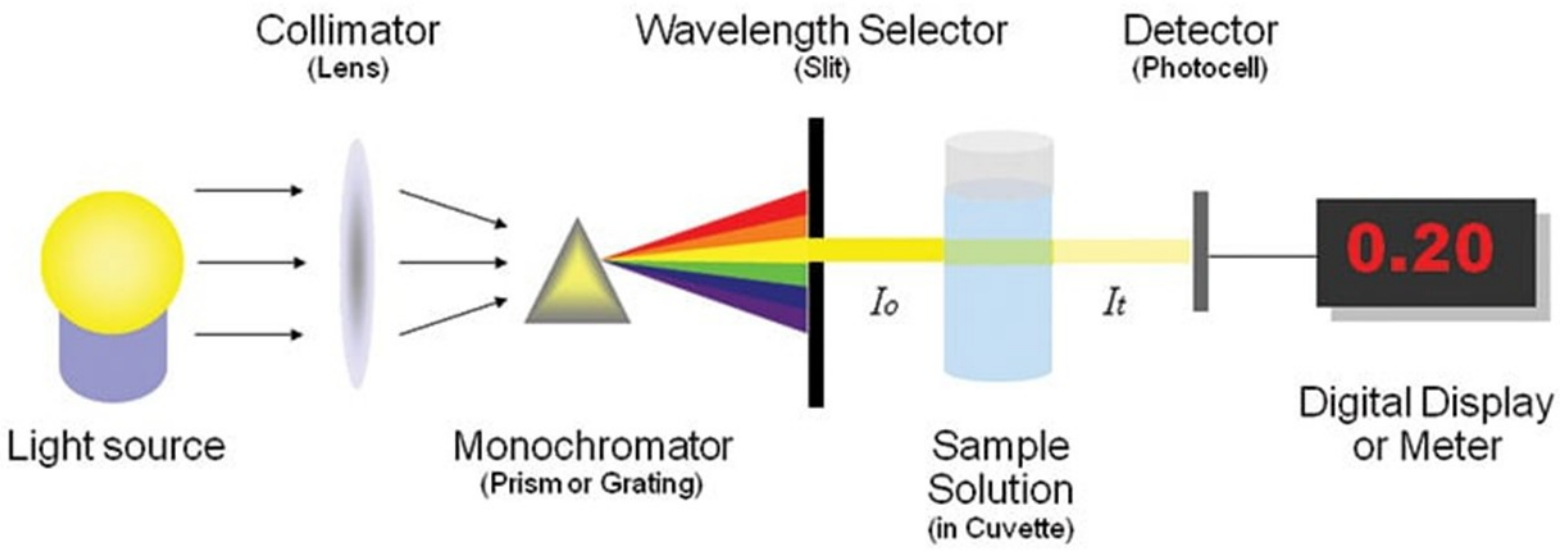

Assessment

2. What is the primary source of radiation used in UV-Visible spectroscopy?

Assessment

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Assessment

3. Which material is preferred for cuvettes when measuring in the UV region?

Assessment

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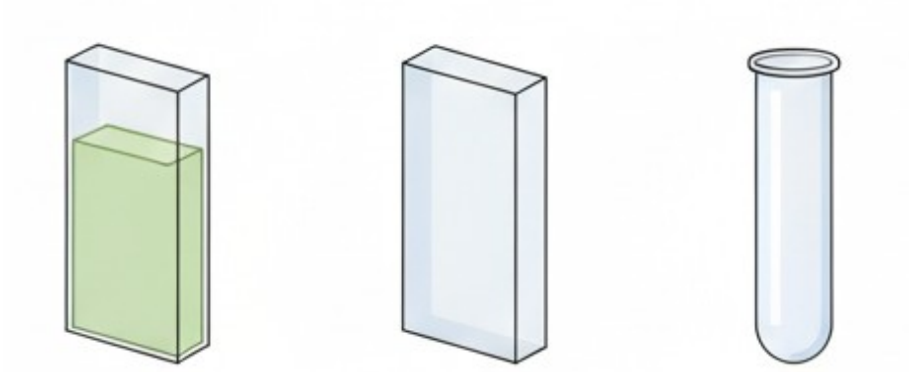

Glass **Quartz** **Plastic**

References

1. Skoog DA, Holler FJ, Crouch SR. *Principles of Instrumental Analysis*. 7th ed. Boston (MA): Cengage Learning; 2018. Chapter 13, Molecular UV-Visible Spectroscopy.
2. Willard HH, Merritt LL, Dean JA, Settle FA. *Instrumental Methods of Analysis*. 7th ed. Belmont (CA): Wadsworth Publishing; 1988. Chapter 6, Spectrometric Methods.
3. Silverstein RM, Webster FX, Kiemle DJ. *Spectrometric Identification of Organic Compounds*. 8th ed. Hoboken (NJ): John Wiley & Sons; 2014. Chapter 8, Ultraviolet Spectroscopy.
4. Kemp W. *Organic Spectroscopy*. 3rd ed. Basingstoke (UK): Macmillan; 1991. Chapter 1, Ultraviolet and Visible Spectroscopy.
5. Sharma YR. *Elementary Organic Spectroscopy: Principles and Chemical Applications*. 5th ed. New Delhi: S Chand Publishing; 2013. Chapter 1, Ultraviolet Spectroscopy.


Thank you!