

Sources of light used in UV Spectroscopy

Conditions for the selection of light (radiation) sources

- The light or radiation source should must be stable
- It should be of sufficient intensity, for the detection at the end of the optical path.
- A continuous source is required whose radiant power doesn't changes sharply over a considerable range of wavelengths.

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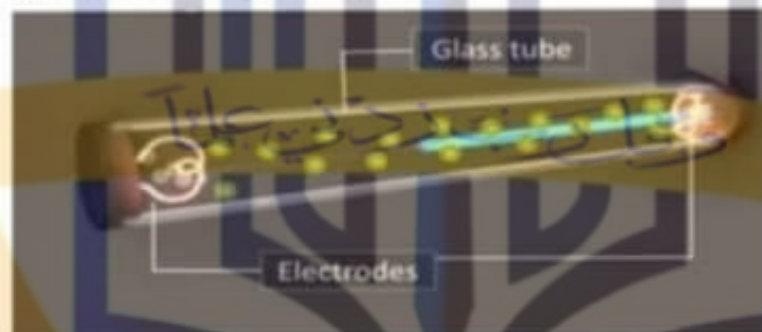
Different light (radiation) sources used in UV Spectroscopy

- Hydrogen Discharge Lamp
- Deuterium Lamp
- Tungsten Filament Lamp
- Xenon Discharge Lamp
- Mercury Arch Lamp
- Light Emitting Diodes

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Hydrogen Discharge Lamp

- In this lamp a pair of electrodes is enclosed in a glass/quartz lamp.
- Hydrogen gas is stored under relatively high pressure.
- Electric current is passed through the pair of electrodes.



- Hydrogen molecules are excited electrically and they emit UV radiation.
- Due to high pressure and electrical heating H- molecules collide with each other. These collisions will increase and H-molecules will emit radiation as continuous band spectra.

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Advantages of Hydrogen Discharge Lamp

- It is continuous source of radiation.
- It covers a range of 160-375 nm.
- It is stable, robust and Widely used.

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Deuterium Lamp

- Most modern lamps of this type contains deuterium and are low voltage type in which an arc is formed between a heated, oxide coated filament and a metal electrode.
- The heated filament provides electrons to maintain a direct current when about 40 V is applied between the filament and the electrode.

Advantages

- The intensity of radiation emitted is 3-5 times The intensity of Hydrogen lamp.
- It gives somewhat larger and brighter ball than hydrogen, which accounts for the widespread use of deuterium.

Disadvantages

- It is expensive than Hydrogen Lamps.
- It is used when high intensity is required.



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Tungsten Filament Lamps

- The most common source of visible and near infrared radiation is the tungsten filament lamp.
- Tungsten-halogen lamps are also called quartz-halogen lamps, which contains a small quantity of iodine within a quartz envelope that houses the tungsten filament.
- Quartz allows the filament to be operated at a temperature of about 3500 K, which leads to higher intensities.



Advantages

- It is useful for the wavelength region between 350 and 2500 nm.
- The lifetime of a tungsten-halogen lamp is more than double that of the ordinary lamp.
- They are significantly more efficient.

Disadvantages

- It is temperature dependent.
- Close voltage control is required for stable radiation source.

Xenon Arc Lamps

- Xenon gas is stored in lamps at 10-30 atm pressure.
- It contains two tungsten electrodes that are separated by a distance of 8mm.
- When current is passed through xenon causes excitation
- Which produces greater UV radiation than Hydrogen Lamp.

Advantages

- It produces a spectrum which is continuous over the range between 200 -1000 nm, with peak intensity occurring at 500nm.



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Light Emitting Diodes

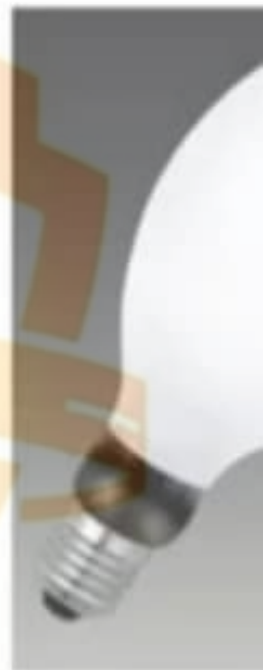
- LEDs can be used as "semi-monochromatic" sources or in conjunction with interference filters to further narrow the spectral output.
- They can be operated in a continuous mode or in pulsed mode.
- "White" LEDs are also available in which the light from a blue LED (Having gallium nitride Diodes) strikes a phosphor.
- It produces a continuous spectrum within the range of 400-800 nm.
- They have long lifetimes and a smaller environmental impact in comparison to tungsten Filament Lamps.



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Mercury Arc Lamp

- In this type of lamp, Mercury vapour is stored under high pressure and the excitation of mercury atoms is done by electric discharge.
- It is more efficient than incandescent and fluorescent lights.
- It produces bright white light with relatively long life.



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- When a beam of monochromatic light radiation is passed through a absorbing medium which contains atoms, ions or molecules then the decrease in the intensity of the radiation or absorbance is directly proportional to the concentration (c) and pathlength (l) of the solution. i.e, $A \propto c.l$
- The various radiation sources used in UV spectroscopy are- Hydrogen Discharge Lamp, Deuterium Lamp, Tungsten Filament Lamp, Xenon Discharge Lamp, Mercury Arc Lamp, Light Emitting Diodes.
- The electrical excitation of Deuterium and Hydrogen at low pressure produces a Continuous UV radiation.
- Both Hydrogen and Deuterium lamps emit radiation in the range of 160nm- 375nm.
- The tungsten filament Lamp is used in wavelength range of 350-2500nm.
- The energy emitted by tungsten filament Lamp is proportional to the fourth Power of operating voltage.

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