Spectrophotometry

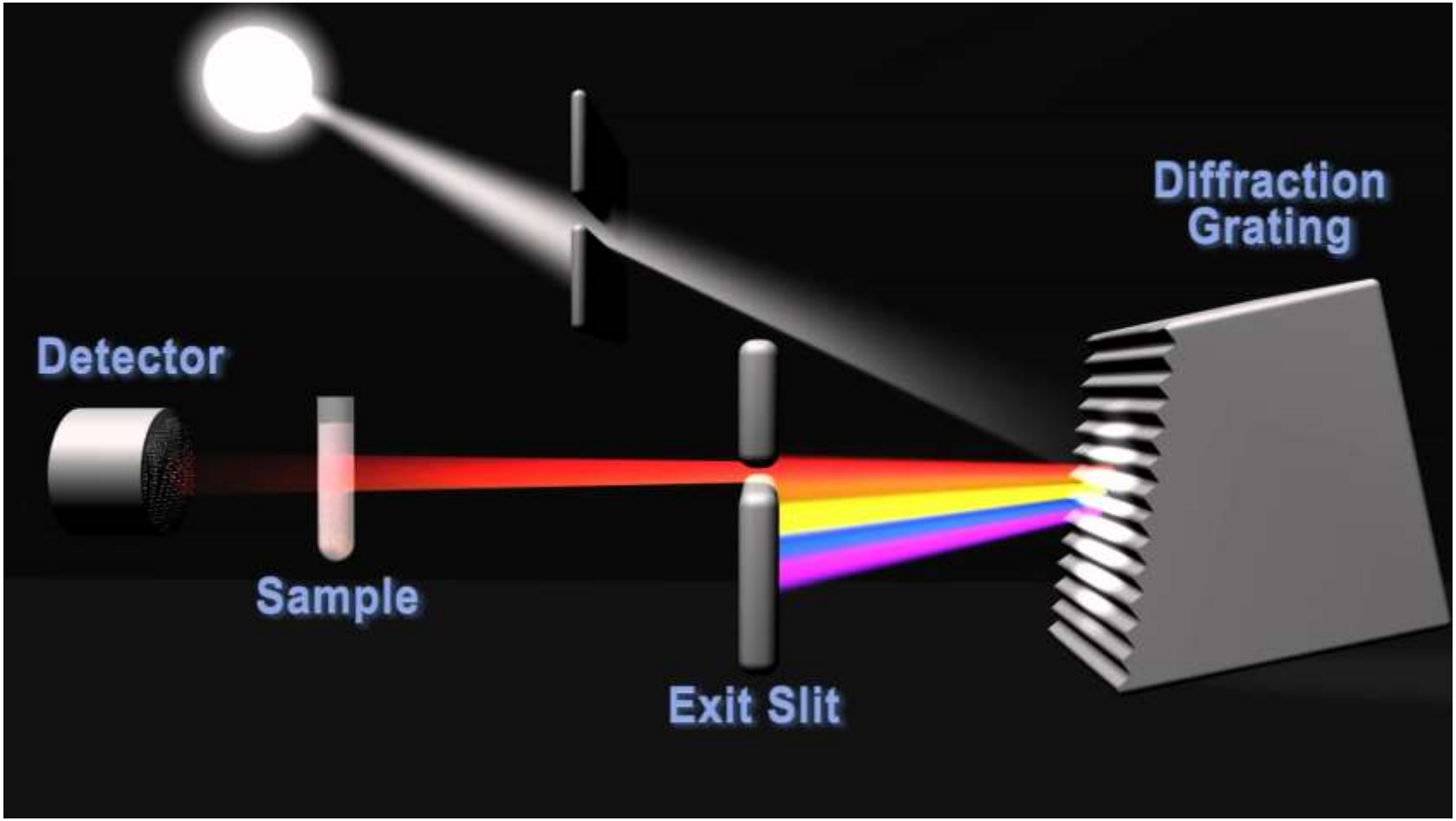
MV

- **spectrophotometry** is the quantitative measurement of the reflection or transmission properties of a material as a function of wavelength
- It is more specific than the general term electromagnetic spectroscopy in that spectrophotometry deals with visible light, near-ultraviolet, and near-infrared, but does not cover time-resolved spectroscopic techniques.

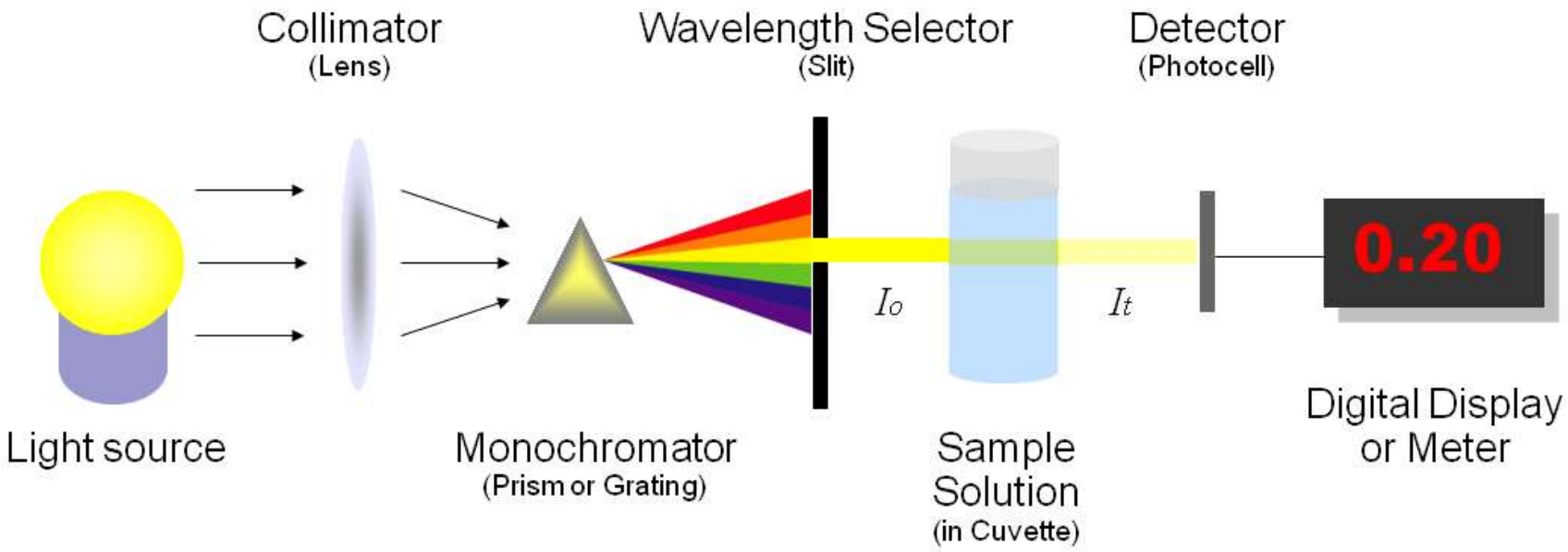
- A **spectrophotometer** is commonly used for the measurement of transmittance or reflectance of solutions, transparent or opaque solids, such as polished glass, or gases.

- Spectrophotometry uses photometers that can measure a light beam's intensity as a function of its color (wavelength) known as spectrophotometers.
- Important features of spectrophotometers are spectral bandwidth, (the range of colors it can transmit through the test sample), and the percentage of sample-transmission, and the logarithmic range of sample-absorption and sometimes a percentage of reflectance measurement.

Schematic representation



Spectrophotometer using Prism



- A spectrophotometer can also be designed to measure the diffusivity on any of the listed light ranges that usually cover around 200 nm - 2500 nm using different controls and calibrations. Within these ranges of light, calibrations are needed on the machine using standards that vary in type depending on the wavelength of the *photometric determination*

- An example of an experiment in which spectrophotometry is used is the determination of the equilibrium constant of a solution. A certain chemical reaction within a solution may occur in a forward and reverse direction where reactants form products and products break down into reactants. At some point, this chemical reaction will reach a point of balance called an equilibrium point. In order to determine the respective concentrations of reactants and products at this point, the light transmittance of the solution can be tested using spectrophotometry. The amount of light that passes through the solution is indicative of the concentration of certain chemicals that do not allow light to pass through.

Utility

- They are widely used in many industries including semiconductors, laser and optical manufacturing, printing and forensic examination, as well in laboratories for the study of chemical substances.
- Ultimately, a spectrophotometer is able to determine, depending on the control or calibration, what substances are present in a target and exactly how much through calculations of observed wavelengths.

- By 1940 several spectrophotometers were available on the market, but early models could not work in the ultraviolet.

Spectrophotometer

Single beam and Double beam

- There are two major classes of devices: single beam and double beam.
- A single-beam spectrophotometer measures the relative light intensity of the beam before and after a test sample is inserted.
- Although comparison measurements from double-beam instruments are easier and more stable, single-beam instruments can have a larger dynamic range and are optically simpler and more compact.

- A double beam spectrophotometer compares the light intensity between two light paths, one path containing a reference sample and the other the test sample.
- A double beam spectrophotometer has a beam splitter that splits the beam into two equidistant paths. The sample is placed in the path of one half of the beam and the reference in the other.