Turbidimetry and Nephelometry

Sritama Mukherjee

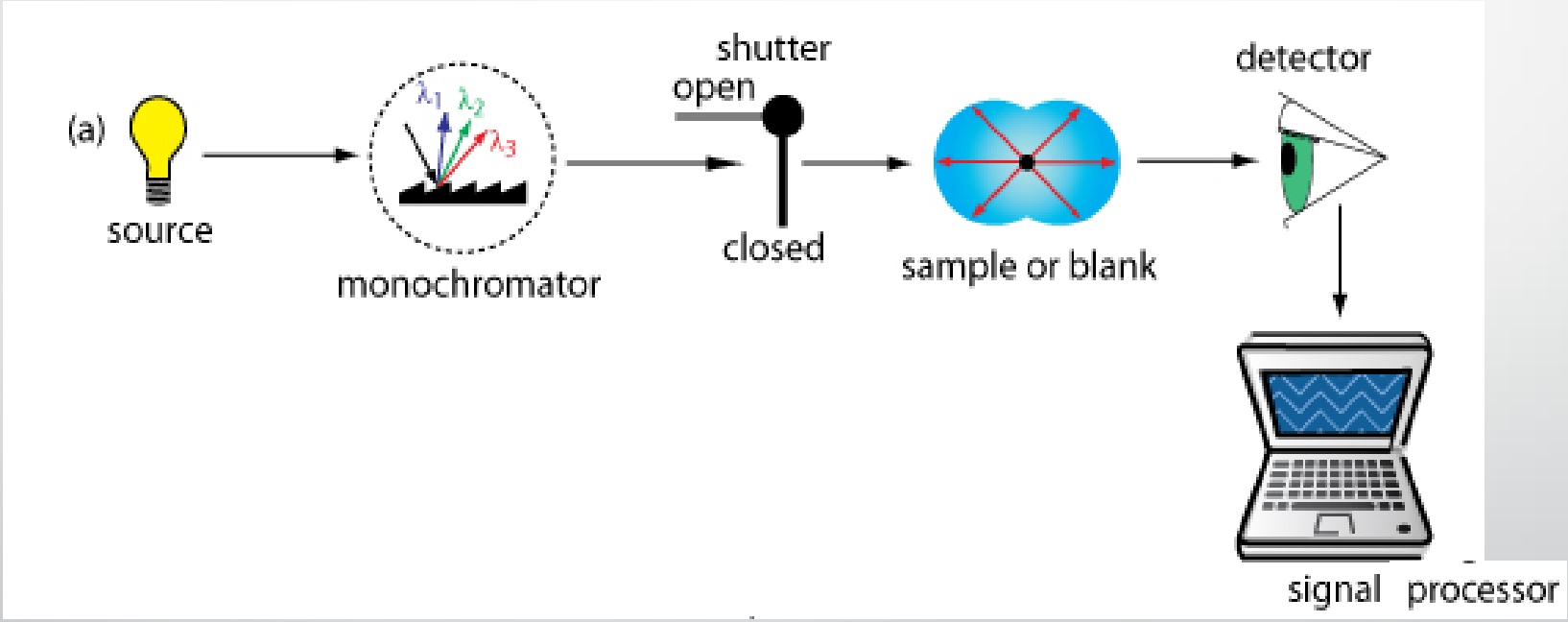
03.11.2018

Introduction

Nephelometry and turbidimetry, in analytical chemistry, methods for determining the amount of cloudiness, or turbidity, in a solution based upon measurement of the effect of this turbidity upon the transmission and scattering of light.

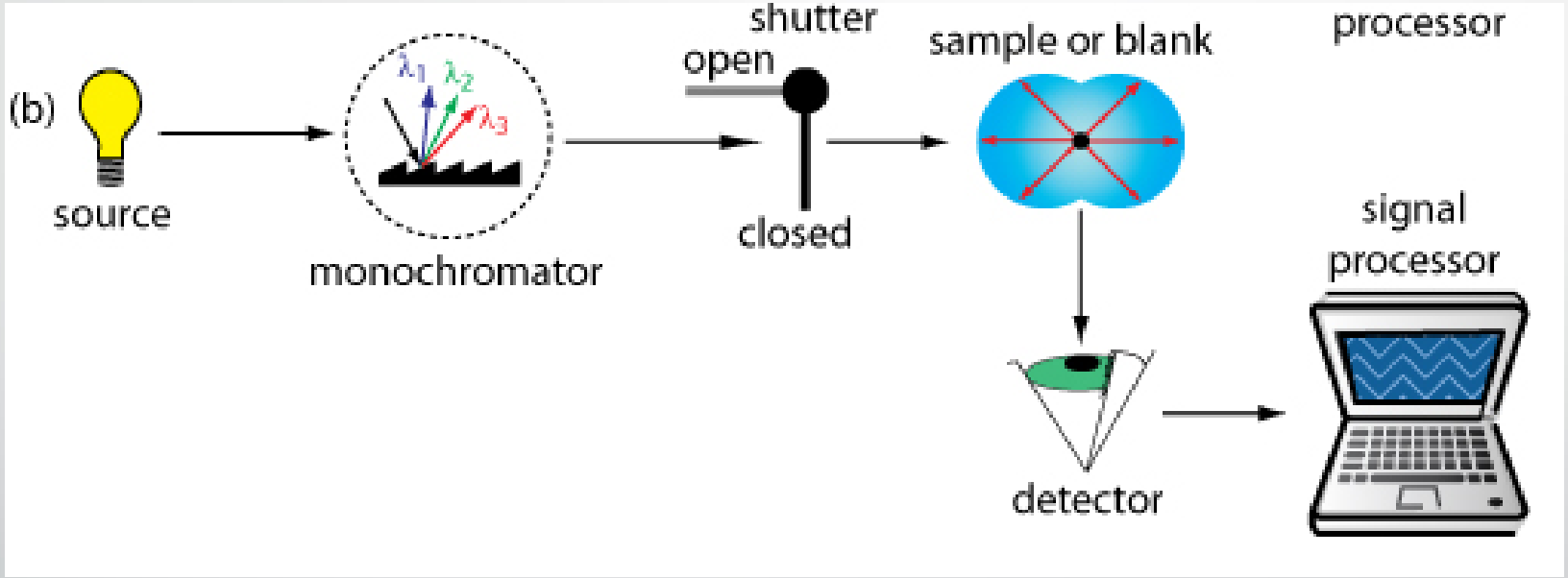
Turbidity in a liquid is caused by the presence of finely divided suspended particles. If a beam of light is passed through a turbid sample, its intensity is reduced by scattering, and the quantity of light scattered is dependent upon the concentration and size distribution of the particles.

Turbidimetry is involved with measuring the amount of transmitted light (and calculating the absorbed light) by particles in suspension to determine the concentration of the substance in question. Amount of absorbed light, and therefore, concentration is dependent on ; a) number of particles, and 2) size of particles.



The detector is placed in line with the source and the decrease in the radiation's transmitted power is measured.

In **nephelometry,** light is passed through the sample solution (suspended particles) directly and the amount of scattered radiation is measured generally at 90°C. The measurement of intensity of scattered light as a function of concentration of dispersed phase is the basis of analysis of nephelometry.



In fact, turbidity can be measured using a UV/Vis spectrophotometer and a spectrofluorimeter is suitable for nephelometry.

It is important to note that in nephelometry incident and scattered light are of same wavelength whereas in fluorimeter (in fluorimetry) scattered light is of longer wavelength than incident light.

Instrumentation

(1) Sources

Monochromatic radiation is used both in turbidimeters and nephelometer. Generally a mercury arc or a laser with special filter combinations for isolating one of its emission lines is the most suitable source.

The tungsten lamp (which is polychromatic source) is used when one has to determine the concentration of a particular substance. It has been observed that even in such a case blue spectral region gives the best results.

(2) Cells

Generally a cell with a rectangular cross section is selected for the study. We can also use cylindrical cells having flat faces where entering and existing beams are passed. The octagonal faces allow measurements to be made at 135°C, 90° 45° or 0° to primary beam. The walls through which light beam are not to pass, are coated black so as to absorb unwanted radiation.

(3) Detectors

In turbidimeters, phototubes are used as detectors.

The photo-mutliplier tubes are used as detectors in case of nephelometers because intensity of scattered radiation is generally very small. Generally the detector is fixed at 90° to primary but for maximum sensitivity the detector angle should vary. There are some nephelometers where detector is mounted on a circular disc which allows measurement at many angles, i.e. at 0° and from 35° to 135°.

Considerations in turbidimetry and nephelometry

• The reaction in turbidimetry & nephelometry does not follow Beer's Law. Therefore, standard curves must be plotted and the concentration of the unknown is determined from the standard curve.

• Because the absorbance is dependent on both number and size of particles, the standard solution which is used for the standard curve must have similar size in suspension as unknown.

• Because some precipitation and settlement of particles may occur with time, in order to obtain good accuracy it is important to ; a) mix the sample well prior to placing the cuvette in the instrument, and, b) keep the same time for measurement of every sample throughout the measurement.

Applications

- Turbidimetry and nephelometry have found many applications in scientific laboratories and in the environmental, chemical, and pharmaceutical sciences and in the foodstuffs, brewing, and beverage industries.
- In addition, turbidimetry and nephelometry are well-established procedures wherever filtration processes have to be carried out, monitored, and controlled.
- Within the hydrologic sciences, and water-supply and waste-water management industries, turbidity values commonly act as simple and convenient surrogate measures of the concentration of suspended solids or of sulfate ions (which are precipitated as $BaSO_4$ in acidic media (HCl) with barium chloride) and other particulate materials.
- Furthermore, atmospheric and space physicists use nephelometric analyses because of the impact of dust scattering by radiative and other processes.
- In quantitative chemical and biological analysis, applications are numerous, especially the calculation of absolute molecular weights and dimensions of polymers in solution, as well as particle size determinations of suspended matter.
- Within microbiology, cell and bacteria growth can be monitored through the media turbidity changes associated with such activity.

Thank you!