

EXP.No. (5)

Measuring the wavelength of light using diffraction grating

The aim of experiment

Determination of the wavelength of the light

Theory

Light is that part of electromagnetic spectrum which can we see. Visible light is emitted by excited atoms and molecules and by very hot solid. The wave length of the visible light between 700nm from red light to 400 nm violet light. The speed of light in vacuum approximately 3×10^8 m/sec.

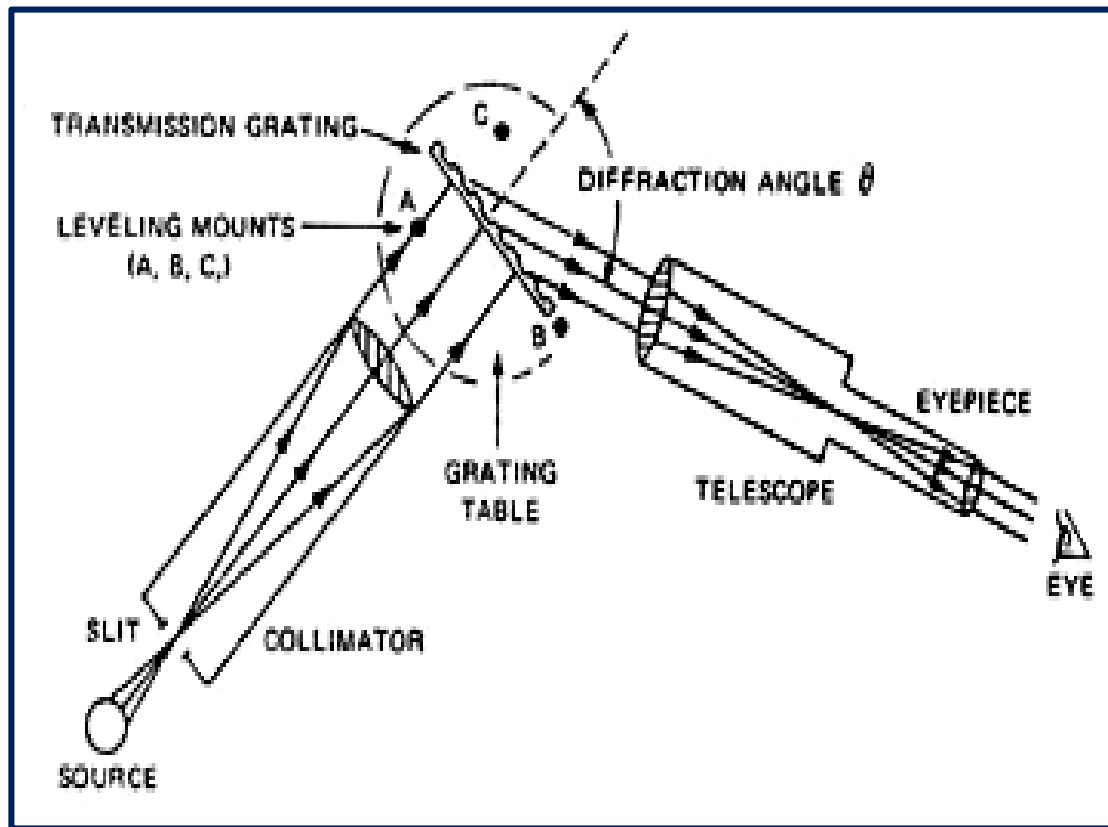
When a light from light tube is observed with spectrometer, the colored images of the entrance grating appear as bright lines separated by dark regions, each gas emits a particular set of spectral lines and its own characteristic spectrum, because every element is clearly defined by its atomic number (Z) in the periodic table of elements. The binding energy or the energy levels are different and characteristic for every element as a result of varying atomic number.

Spectrometer: - is an instrument used to observe and measure the angular deviation of light due to deviator system as prisms and diffraction gratings.

It consists essentially of three parts:

1. The collimator: which provides parallel beam of light from the source . It consists of chromatic lens at one end and adjustable slit at the other .
2. Diffraction grating: is a diverging device that deviated light according to wavelength .It separates the light into its component colors.
3. The telescope: which receives the dispersed light from the grating . Its provided with an eyepiece fitted with cross-hairs.

The optical axes of the collimator and the telescope meet on the axis of rotation of table carrying the grating as shown in figure below



Apparatus

Spectrometer , diffraction grating , lamp.

Methodology

- a) Experiment should be performed in dark room.
- b) Place a light source in front of the collimator and turn it on .
- c) Place the telescope in front of the collimator, look through the telescope and close the slit of collimator to the light source until the image of slit is clearly seen in the center of the vision field .
- d) Fix the grating on the table of spectrometer with its plane perpendicular to the optical axis .
- e) Rotate the telescope until the cross-hair matches the center of the line .
- f) Read the vernier's scales with magnifying glass .

To read the angle, first find where the zero point of vernier's scale. Then, read the value which is located directly below the zero point on the graduated plate. If the zero point locates in between two values, depend the lower value.

Calculation:-

Read the telescope vernier angles ($\alpha_R - \alpha_L$) when the center of cross hairs coincides with each of the first-order diffracted image.

The difference between ($\alpha_R - \alpha_L$) is equal to twice the angle θ of the order diffraction.

Final equation:

$$S \sin \theta = n \lambda$$

where S is grating spacing = $1/N$, where N is the number of lines per cm , n= number of order.

Medical application

1-For glucose monitoring in diabetic patents .

2-To measure changes in chemicals and enzymes ,as it is very difficult to monitor these aspects of human body.

3- Use wavelength near IR to analyzed metabolites and proteins .

4-Tt is used to identify cancerous liver cells.