Diffraction Grating

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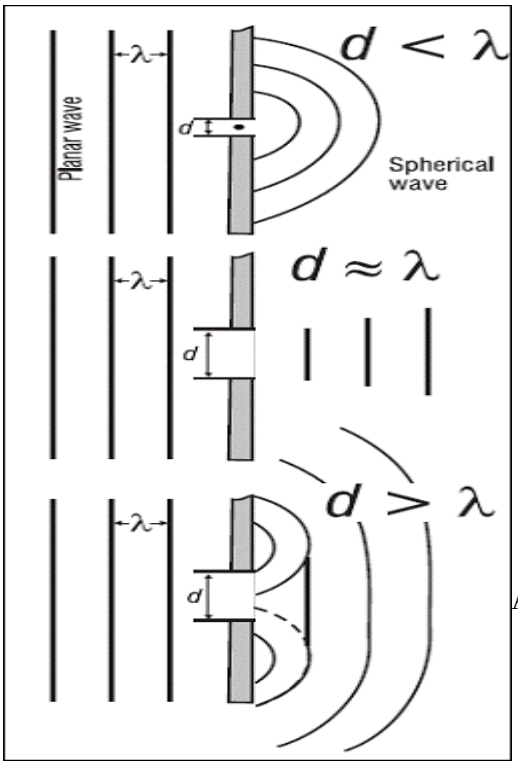
Introduction to Diffraction Gratings

What is a Diffraction Grating?



A diffraction grating is a device that reflects or refracts light by an amount that varies according to wavelength. A diffraction grating can be modeled as a finite series of alternating transparent and opaque, long, parallel stripes. A diffraction grating is an optical device that is used to learn the different wavelengths or colors contained in a beam of light. The device usually consists of thousands of narrow, closely spaced parallel slits (or grooves). Due tointerference , the intensity of the light that passes through the slits will depend on the direction of the light propagation. In select directions, the light waves from the different slits interfere in phase, and in these directions one observes maximum light intensities. These selected directions depend on wavelength. Therefore, light beams with different wavelengths will propagate in different directions

Working Principle

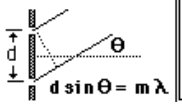
The working principle of a diffraction grating is based on the phenomenon of diffraction. The spaces between lines act as slits and these slits diffract light waves in these places by producing numerous beams that interfere in ways that produce spectra.
The distance between two consecutive slits (lines) of a grating is called a grating element. If 'a' is the separation between two slits and 'b' is the width of a slit, then grating element 'd' will be:

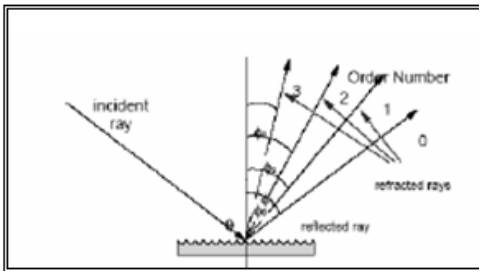
$d = a + b$,

or, d = the length of grating/no. of lines

Wavelength of light by a diffraction grating

A diffraction gratings is the tool of choice to separate the colors in incident light.





m

m? = g(sin????sin?)

Where
g = spacing
m = order of the refracted ray
?= free space wavelength of incident ray
q= angle of incidence (measured against normal)
$?_m$ = angle of refraction (measured against normal)
This equation is called the "grating equation" and is used to determine the wavelength of light.
'm' is called the order of grating and is the number of bright or dark fringes obtained on the screen.

For m=0 , ?=0, central bright maxima of zero order.
m=1 , ?=?1, 1st order bright maxima (path difference = ??
m=2 , ?=?2, 2nd order bright maxima (path difference = 2?)

With increases in 'm', fringes of decreasing width and less brightness are obtained.

No order of line is possible at ?>90°.

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