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Experiment-2

Title :-

Measurement of lawdimension by laser diffraction

Objectives:

a) To determine the wavelength of the given laser source using a diffraction.

b) To determine the particle size of the thin film coated on the glass slide.

Calculations:

In the first step, measure D, and find y corresponding to each other of diffraction. find the corresponding angle and substitute it in the equation for λ. In the single slit experiment, repeat the measurement for D and y. Calculate the angle for each order of diffraction. find the slit width by using the wavelength of the laser obtained in the first part.

Laboratory report:

(a) Determination of wavelength

S/NO	ORDER of diffraction (n)	Distance b/w grating and Diffraction spot (D)	Distance b/w Diffraction spot & centre maxima (Y)	θ	λ (nm)
1.	1	10	3.4cm	18.778	544 nm
2.	1	8	2.7cm	18.649	540.4 nm
3.	1	7	2.5cm	19.650	568.3 nm
4.	2	10	7.8cm	37.954	519.6 nm
5.	2	8	6.5cm	39.093	532 nm
6.	2	7	6.3cm	41.531	560.2 nm

d = 1.69 μm Average wavelength = 544.22nm

$\left[\frac{\Sigma\lambda}{6}\right]$ = 544.22nm

(b) Determination of particle size:-

S/NO	Order(n)	Distance b/w grating Slit & Screen (d) (cm)	Diameter of the Circle (cm)	Radius of the circle (cm)	Particle Size. $D=\frac{1.22n\lambda d}{r(cm)}$
1.	1	9	1.5	0.75	7.964×10^{-6}
2.	1	7	0.3	0.15	3.097×10^{-6}
3.	2	9	3	1.5	7.946×10^{-6}
4.	2	7	0.5	0.25	37.16×10^{-6}

Average particle size

$= 21.0145\times10^{-6}$m.

Calculations:

(a) $\tan\theta = Y/D$, $\lambda = \frac{d\sin\theta}{n}$, $\theta = \tan^{-1}(Y/D)$

for 1st order:-

(1) $\theta = \tan^{-1}\left(\frac{3.4}{10}\right) = \tan^{-1}(0.34) = 18.778$

$\lambda = \frac{1.69\times10^{-6}\times\sin(18.778)}{1} = 0.544\times10^{-6}m$

$= 544nm.$

(2) $\theta = \tan^{-1}\left(\frac{2.7}{8}\right) = \tan^{-1}(0.3375) = 18.649$

$\lambda = \frac{1.69\times10^{-6}\times\sin(18.649)}{1} = 0.5404\times10^{-6}m$

$= 540.4nm$

(3) $\theta = \tan^{-1}\left(\frac{2.5}{7}\right) = \tan^{-1}(0.3571) = 19.651$

$\lambda = \frac{1.69\times10^{-6}\times\sin(19.651)}{1} = 0.5683\times10^{-6}m.$

$= 568.3nm$

for second order:-

(4) $\theta = \tan^{-1}\left(\frac{7.8}{10}\right) = \tan^{-1}(0.78) = 39.754$

$\lambda = \frac{1.69\times10^{-6}\times\sin(39.754)}{2} = 519.6nm$

(5) $\theta = \tan^{-1}\left(\frac{6.5}{8}\right) = \tan^{-1}(0.8125) = 39.093$

$\lambda = \frac{1.69\times10^{-6}\times\sin(39.093)}{2} = 532.8nm.$

(6) $\theta = \tan^{-1}\left(\frac{6.3}{7}\right) = \tan^{-1}(0.8857) = 41.531$

$\lambda = \frac{1.69\times10^{-6}\times\sin(41.531)}{2} = 560.2nm$

(b) $D = \frac{1.22 n \lambda d}{r}$

(1) $D = \frac{1.22 \times 1 \times 0.544 \times 10^{-6} \times 9}{0.75} = 7.9642 \times 10^{-6} m$

(2) $D = \frac{1.22 \times 1 \times 0.544 \times 10^{-6} \times 7}{0.15} = 30.97 \times 10^{-6} m$

(3) $D = \frac{1.22 \times 2 \times 0.544 \times 10^{-6} \times 9}{1.50} = 7.964 \times 10^{-6} m.$

(4) $D = \frac{1.22 \times 2 \times 0.544 \times 10^{-6} \times 7}{0.25} = 37.16 \times 10^{-6} m.$

Result :-

The wavelength of laser = 544.22 nm

The width of Single Slit = $21.0145 \times 10^{-6} m$