

实验二. 最小偏向角测棱镜折射率

i. 原始数据

组别	入射光		折射光		最小偏向角 (计算得)
	α	β	α'	β'	$\delta_m = \frac{1}{2}(\alpha' + \beta' - \alpha - \beta)$
1	253°1'	73°3'	303°52'	123°53'	50°50'30"
2	276°22'	126°22'	347°13'	167°12'	50°50'30"
3	53°54'	223°53'	104°44'	104°45'	50°51'00"
4	114°18'	294°16'	165°10'	345°9'	50°52'20"
5	22°11'	202°8'	73°4'	253°4'	50°54'30"

ii. 数据处理, 最小偏向角 $\delta_m = \frac{1}{2}(\alpha' + \beta' - \alpha - \beta)$. 若 $\delta_m < 0$ 则 $\delta_m = 180^\circ + \frac{1}{2}(\alpha' + \beta' - \alpha - \beta)$

$$\delta_m = \frac{\sum_{i=1}^6 \delta_{m_i}}{6} = \frac{50^\circ 51' 48''}{6} = 50^\circ 52' = 50.87^\circ$$

取 $A = 60.00^\circ$

∴ 棱镜折射率 $n = \frac{\sin(\frac{\delta_m + A}{2})}{\sin(\frac{A}{2})} = 1.6470$

iii. 不确定度的计算

δ_m 的 A 类不确定度: $u_a(\delta_m) = \sqrt{\frac{\sum (\delta_{m_i} - \delta_m)^2}{5 \times 4}} = 0.0129^\circ$

δ_m 的 B 类不确定度: $u_b(\delta_m) = \frac{\Delta_{\delta_m}}{\sqrt{3}} = 0.0096^\circ$

故 $u(\delta_m) = \sqrt{u_a(\delta_m)^2 + u_b(\delta_m)^2} = 0.0161^\circ = 2.81 \times 10^{-4}$

取 $u(A) = 0.006^\circ = 1.04 \times 10^{-4}$

由 $n = \frac{\sin(\frac{\delta_m + A}{2})}{\sin \frac{A}{2}}$ 得: $u(n) = \sqrt{\left[\frac{\partial n}{\partial \delta_m} u(\delta_m)\right]^2 + \left[\frac{\partial n}{\partial A} u(A)\right]^2}$

∴ $\frac{\partial n}{\partial \delta_m} = \frac{\cos(\frac{\delta_m + A}{2})}{2 \sin \frac{A}{2}} = 0.567$

$\frac{\partial n}{\partial A} = \frac{\cos(\frac{\delta_m + A}{2}) \sin(\frac{A}{2}) - \cos \frac{A}{2} \sin(\frac{\delta_m + A}{2})}{2 \sin^2 \frac{A}{2}}$
 $= \frac{-\sin \frac{\delta_m}{2}}{2 \sin^2 \frac{A}{2}} = -0.859$

∴ $u(n) = 1.83 \times 10^{-4} = 0.0002$

∴ $n = (1.6470 \pm 0.0002)$