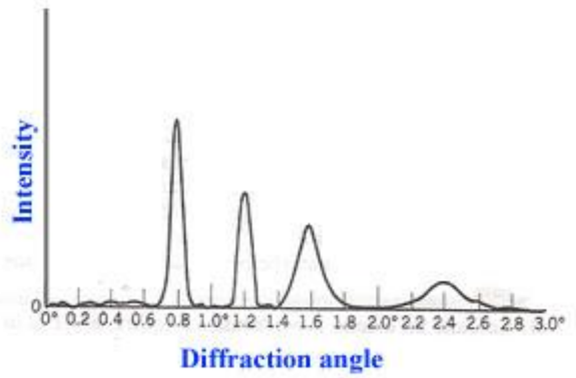
684.

Problem 47.33 (RHK)

An x-ray beam, containing radiation of two distinct wavelengths, is scattered from a crystal, yielding the intensity spectrum, as shown in the figure. The interplanar spacing of the scattering planes is 0.94 nm. *We have to determine the wavelength of the x rays present in the beam.*



Solution:

The Bragg' law for crystal diffraction is

$$2d\sin\theta = m\lambda,\ m = 1, 2, 3, \ldots$$

where d is the lattice spacing.

From the figure we note that the scattering angles are small and $\sin\theta \approx \theta$.

From the intensity pattern shown in the figure, we note that diffraction intensity peaks at 0.8^0, and 1.6^0 correspond to first and second diffraction orders for one wavelength, and those at 1.2^0, and 2.4^0 correspond to the first and second diffraction orders for the second wavelength.

We thus have

$$\frac{\lambda_1}{\lambda_2} = \frac{\sin\theta_1}{\sin\theta_2} = \frac{\sin 0.8^0}{\sin 1.2^0} = \frac{1.39\times10^{-2}}{2.09\times10^{-2}} = 6.65\times10^{-1}.$$

The lattice spacing

$$d = 0.94 \text{ nm.}$$

Using the Bragg's law we find that the radiation contains the following two wavelengths;

$$\lambda_1 = 2\times0.94\times\sin 0.8^0 \text{ nm} = 0.026 \text{ nm} = 26 \text{ pm},$$

and

$$\lambda_2 = \frac{\lambda_1}{0.665} = 39 \text{ pm.}$$