

683.

Problem 47.31 (RHK)

A beam of x rays of wavelength 29.3 pm is incident on a calcite crystal of lattice spacing 0.313 nm. We have to find the smallest angle between the crystal planes and the beam that will result in constructive reflection of the x rays.

Solution:

The Bragg' law for crystal diffraction is

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

where d is the lattice spacing.

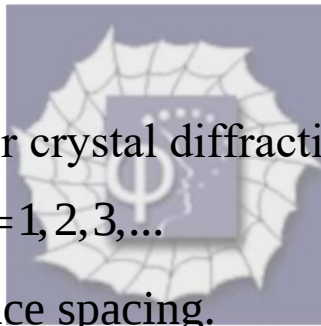
It is given that

$$d = 0.313 \text{ nm},$$

and

$$\lambda = 29.3 \text{ pm} = 0.0293 \text{ nm}.$$

Therefore, the smallest angle between the crystal planes and the beam that will result in constructive interference will be



$$\sin \theta = \frac{\lambda}{2d} = \frac{0.0293}{2 \times 0.313} = 4.48 \times 10^{-2},$$

and

$$\theta = \sin^{-1}(4.48 \times 10^{-2}) = 4.68 \times 10^{-2} \text{ rad} = 2.68^\circ.$$

