Interplanar Spacing and Bragg Diffraction Angle (Cubic)

Spacing of (hkl) planes in a cubic crystal from the lattice parameter and the Bragg diffraction angle 2θ for an X-ray wavelength and reflection order.

Method: Bragg's law for cubic crystals

Input parameters

Unit system: SI

Parameter	Value	Unit
Lattice parameter	0.28660	nm
Miller index h	2.0000	
Miller index k	1.0000	
Miller index l	1.0000	
X-ray wavelength	0.15406	nm
Reflection order	1.0000	

Calculated results

Parameter	Value	Unit
Interplanar spacing	0.11700	nm
Bragg angle	41.174	°
Diffraction angle 2θ	82.349	°
Sum of squared indices	6.0000	

Notes for this case

• Cubic crystals: d = a/√(h² + k² + l²). Bragg: nλ = 2d sin θ. Not every plane diffracts: BCC needs h + k + l even, FCC needs h, k, l all odd or all even (structure factor), which is how XRD patterns identify the lattice. Default: the (211) reflection of α-iron with Cu-Kα$_1$ radiation.

Formula and method

$$d_{hkl} = \frac{a}{\sqrt{h^2 + k^2 + l^2}}, \quad n\lambda = 2d\sin\theta$$

Variables

a	Lattice parameter	m
h	Miller index h	-
k	Miller index k	-
l	Miller index l	-
λ	X-ray wavelength	m
n	Reflection order	-
d_{hkl}	Interplanar spacing	m
θ	Bragg angle	rad
2θ	Diffraction angle 2θ	rad
$h^2 + k^2 + l^2$	Sum of squared indices	-

Method and standards

Bragg diffraction.

Assumptions and limits

- Cubic lattice; kinematic diffraction.

References

Bragg's law for cubic crystals

Report details

Report reference	FCC-ACB9-PCGP (the same inputs always give the same reference)
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Release checks	3 reference cases of this calculator, computed independently, are checked on every release

Results are for engineering estimation. Verify critical designs against the referenced standards and your own data.

This calculator online

https://calc.firecad.com/materials/properties/interplanar-spacing-bragg

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.