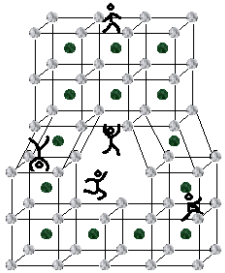


Seeing Right Through

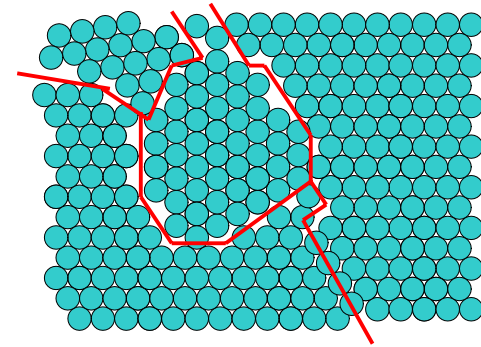


- Lattices...Left Overs
- X-Ray Diffraction
 - Bragg Condition
 - Interplanar Spacing Formula
 - Structure Factors (Forbidden Symmetry)
- Reciprocal Space (Not in Book!)
- (For more see B. D. Cullity, *Elements of X Ray Diffraction*)

Monday,
Sept. 8, 2003

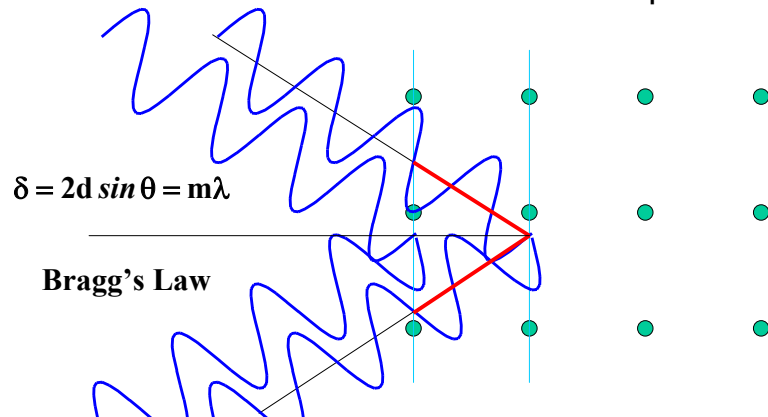
MATS275: INTRODUCTION
TO MATERIALS SCIENCE

Polycrystalline Material

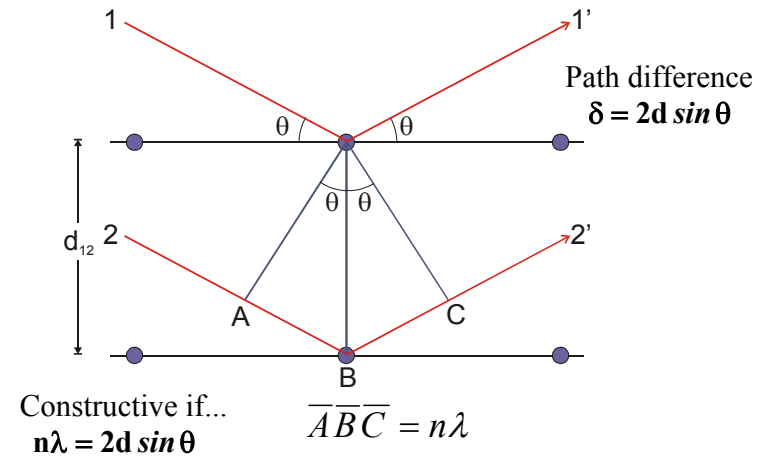


A Really Small Grating

- Planes reflect waves over different paths.



Deriving Bragg's Law



The Bragg Condition

- Spacing between planes

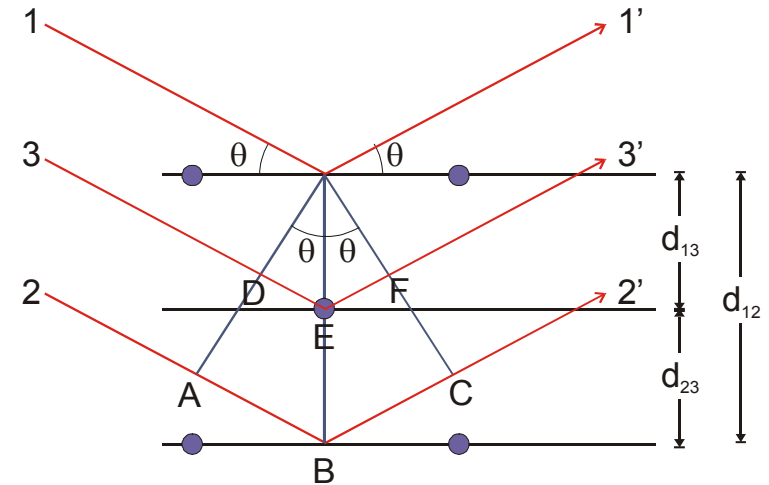
– Cubic

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

– Hexagonal

$$d_{hkil} = \frac{a}{\sqrt{(h^2 + hk + k^2) + l^2 \left(\frac{a}{c}\right)^2}} \quad 2a \sin \theta = \lambda \sqrt{(h^2 + hk + k^2) + l^2 \left(\frac{a}{c}\right)^2}$$

Forbidden Diffraction



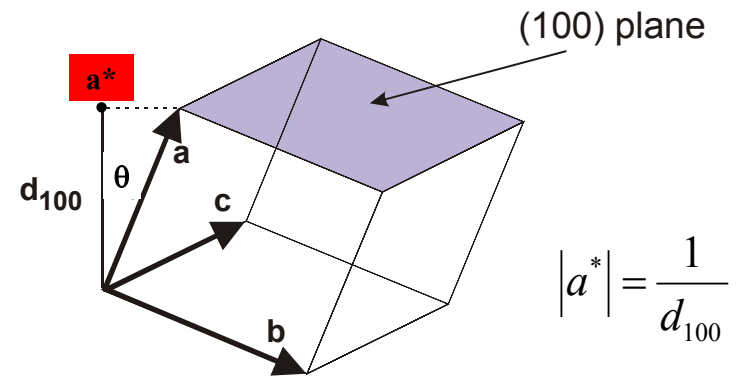
Selection Rules

	Allowed	Forbidden
• Primitive	all	none
• BCC	$h+k+l = \text{even}$	$h+k+l = \text{odd}$
• FCC	hkl all even or all odd	hkl mixed
• HCP	everything else	$h+2k=3n, l = \text{odd}$

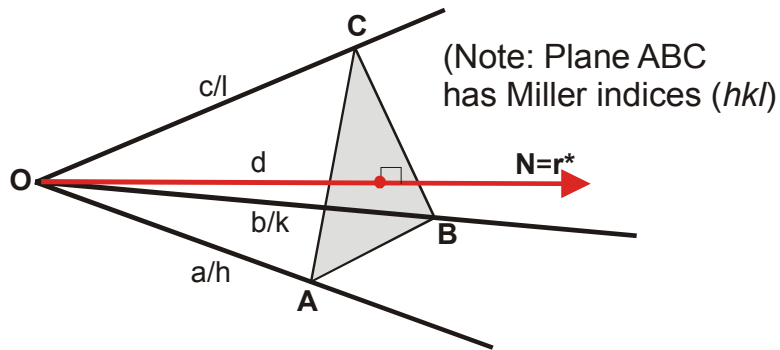
$$F(hkl) = \sum f_n \exp[2\pi i(nu_n + kv_n + lw_n)]$$

$$I = FF^*$$

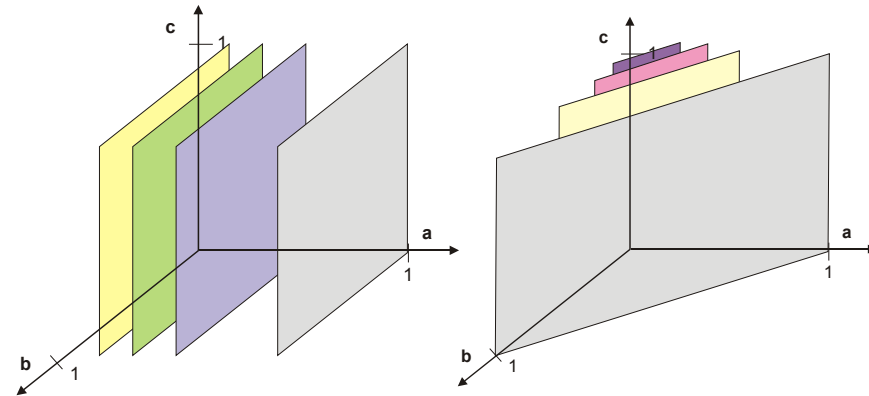
Reciprocal Lattice



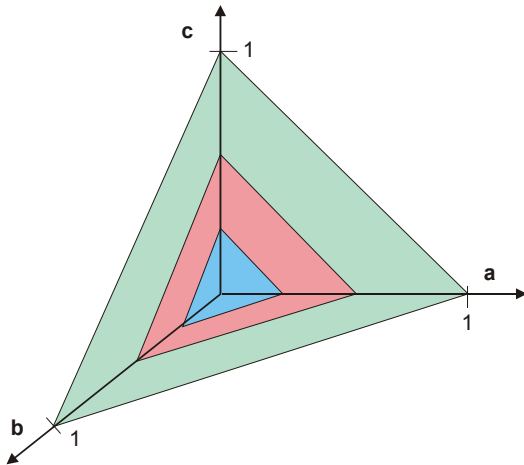
$$\mathbf{r}_{hkl}^* \perp (hkl)$$



Real to Reciprocal Space...



$(111), (222), (333)$



Reciprocal Distances

Miller Indices	$1/d^2$ (distance formula)	$1/d$ (reciprocal distances)
100	1/16	0.25
200	4/16	0.5
300	9/16	0.75
400	16/16	1.00
110	2/16	0.345
220	8/16	0.707
330	18/16	1.061
440	32/16	1.414
210	5/16	0.56
111	3/16	0.433
112	6/16	0.612
222	12/16	0.866

Draw a Reciprocal Space Coordinate System

