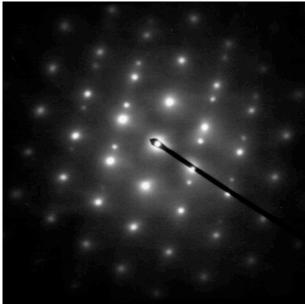
090522 Quiz 5 XRD

1) Construct the Sphere of Reflection by sketching a reciprocal lattice with an origin, (000) and the center of the diffraction measurement indicating 2θ and $(S - S_0)/\lambda$. Why are only a few peaks seen when a perfect crystal diffracts with a single wavelength x-ray radiation?

2) The following electron diffraction pattern is from an austenite phase of steel. Explain how this relates to inverse space and why electron diffraction patterns appear different than x-ray diffraction patterns.



3) Construct the limiting sphere and explain why Debye-Scherrer rings are seen from a powder pattern in a 2D photographic measurement such as was done in lab 2.

4) Explain why for FCC the unit cell structure factor, F, is 4f for unmixed hkl and is 0 for mixed hkl where f is the atomic form factor.

5) Sketch the atomic form factor (I versus 2θ) and explain why the function has this shape.

1) Sphered Reflection Cor (Ewald Sphere) It is an likely that a siven point will interest the sphered 00 fixed radius, in a fixed orientation relative to the laff: p

2) The wavelength of electrons is two orders smaller than the wavelength of x-rays so the sphere of reflection is two orders larger in diameter. The sphere is basically close to a flat sheet compared to the lattice size so we observe many more reflections in the electron diffraction pattern compared to an x-ray diffraction pattern. The Ewald sphere for electrons can align with the inverse space lattice to yield many reflections as shown in the figure.

By rotation of the curral to all possible originate fimi the sphere of notice tion traces out a larger sphere of radius a called the limity sphere For the intersection of the Ewalds place with a recpiceal (affice point votating the lattice will trace out a circle on the randou of the two ld sphere creating a Desye- Schewer ring on the film which is part of the surface Limity Spleip

4) 4 atoms (0,0,0); (1/2,1/2,0); (1/2,0,1/2); (0,1/2,1/2)

$$F = f[1 + e^{(\pi i(h+k))} + e^{\pi i(h+l)} + e^{\pi i(k+l)}]$$

for Unmixed hkl
$$\Rightarrow$$
 F = 4f and F² = 16f²

for Mixed $hkl \Rightarrow F = 0$

i.e. no (100) reflections but will have (111), (200) etc.

5) Plot of f versus 2 θ .



f shows a monotonic decay with 2 θ because it represents the Fourier transform of the electron density distribution function for an electron cloud which is basically a Gaussian (bell shaped) function. The Fourier transform of a Gaussian is another Gaussian which is a monotonic decay curve of the type shown above.