ESO 205T

Nature and Properties of Materials

Interaction session: 11-12 Monday
Tutorial: 11-12 Thursday

Assignment 6

Due by 29 October 2020 11 am

Question 1

Determine the reciprocal lattice of FCC and BCC crystal with lattice parameter of "a".

Question 2

Determine the structure factor FCC copper and specify the first 10 peaks for FCC copper.

Question 3

Index the peaks for FCC FeMnNi alloy using copper K alpha radiation with wavelength of 0.1542 nm provided below. Find the lattice parameter from the first 5 peaks and comment on the choice of the precise lattice parameter value.

X-ray diffraction pattern for FeMnNi alloy
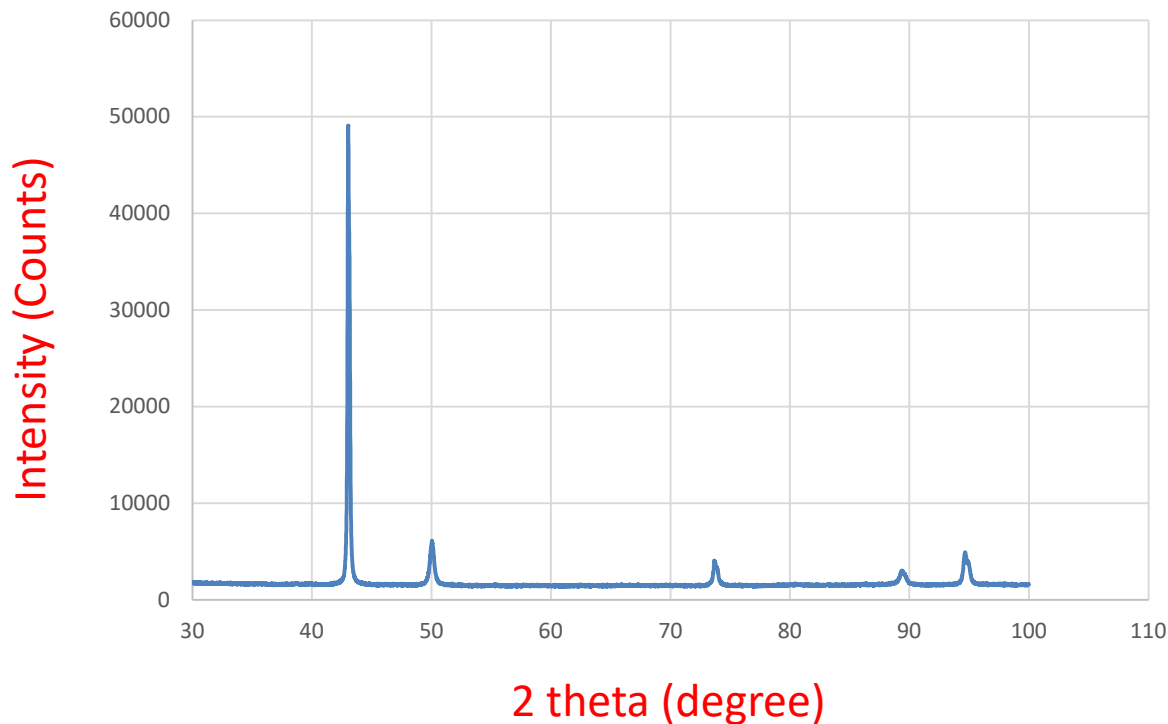
Peak No.	[2Th.] °
1	43.0202
2	50.001
3	73.6751
4	89.3558
5	94.6445

Question 4

The Brillouin zone is a very important concept in solid state physics; it plays a major role in the theoretical understanding of the elementary ideas of electronic energy bands. Determine the irreducible Brillouin zone for a square lattice with dimension "a".

The irreducible Brillouin zone is obtained by determining the first Brillouin zone reduced by all the point group symmetries of the lattice. The first Brillouin zone is the locus of points closer to the origin and can be obtained by determining the region surrounded by drawing perpendicular bisectors to the nearest neighbour from the origin.

Question 5

Find the resolution of an optical microscope with a numerical aperture of 1.5 for red, green and blue light.

Question 6

Determine the wavelength of electron beam for a SEM operating at 20kV and TEM operating at 200 kV. We have discussed about the best resolution in SEM and TEM. Comment on the poor resolution in electron microscopes compared to the wavelength of radiation used in the same.

Remember to use the relativistic correction for mass of an electron when necessary.