Háskóli Íslands
Raunvísindadeild
Eðlisfræði

Haust 2015

Eðlisfræði þéttefnis I

Dæmablað 5

Skilafrestur 29. September 2015 kl. 15:00

1. **X-ray energy** (10)

   The minimum wavelength observed in X-ray diffraction is $\lambda = 1.23$ Å. What is the kinetic energy, in eV, of the primary electron hitting the target ?

2. **Primitive unit cell** (10)

   Show that the volume of the primitive unit cell is $a^3/2$ for the bcc lattice and $a^3/4$ for the fcc lattice, where a is the side of the cube.

3. **Neutrons vs electrons** (10)

   Why is the energy of a neutron so much smaller than that of an electron in radiation beams employed in crystal diffraction ?

4. **Diamond and silicon lattice** (10)

   Diamond and silicon have the same type of lattice structure, an fcc with a basis, but different lattice constants. Is the lattice structure factor S the same for both substances ?

5. **Structure factor of diamond lattice** (10)

   The diamond structure is described in your text. The basis consists of eight atoms if the unit cell is taken as the conventional cube.

   (a) Find the structure factor S of this basis.

(b) Find the zeros of S and show that the allowed reflections of the diamond structure satisfy $h + k + l = 4n$, where all indices are even and n is any integer, or else all indices are odd.

6. **Real lattice vector and reciprocal vector** (10)

   Does a real lattice vector have a corresponding unique reciprocal vector ?

7. **X-ray diffraction** (10)

   The edge of a unit cell in a cubic crystal is $a = 2.62$ Å. Find the Bragg angle corresponding to reflection from the planes (100), (110), (111), (200), (210), and (211), given that the monochromatic X-ray beam has a wavelength $\lambda = 1.54$ Å.