University of Zurich[UZH]

Solid State Physics
Exercise Sheet 2
Reciprocal Lattice

HS19
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Reciprocal lattices

Exercise 1 *General properties*

1. Show that a reciprocal lattice vector $\vec{G} = h\vec{b}_1 + k\vec{b}_2 + l\vec{b}_3$ is orthogonal to the lattice plane (hkl).
2. Show that the distance d_{hkl} between two consecutive lattice planes with Miller indices (hkl) is given by $d_{hkl} = \frac{2\pi}{|\vec{G}|}$.
3. Express d_{hkl} for a cubic, a tetragonal and an orthorhombic lattice.

Exercise 2 *Reciprocal lattices*

Calculate the primitive reciprocal lattice vectors $\vec{b}_1$, $\vec{b}_2$, $\vec{b}_3$ for

1. face-centered cubic (fcc)
2. base-centered cubic (bcc)
3. simple hexagonal (Hint: For simple hexagonal use these primitive vectors: $\vec{a_1} = \frac{\sqrt{3}}{2}a\vec{e_x} + \frac{a}{2}\vec{e_y},\ \vec{a_2} = -\frac{\sqrt{3}}{2}a\vec{e_x} + \frac{a}{2}\vec{e_y},\ \vec{a_3} = c\vec{e_z}$)

Exercise 3 *Brillouin zones*

Graphite is a lamellar crystal in which single layers of carbon atoms (or graphene) are distributed at the points of regular hexagons to form a honeycomb pattern.

1. Characterize this 2D structure by its Bravais lattice and basis
2. Sketch the corresponding reciprocal lattice and the first three Brillouin zones