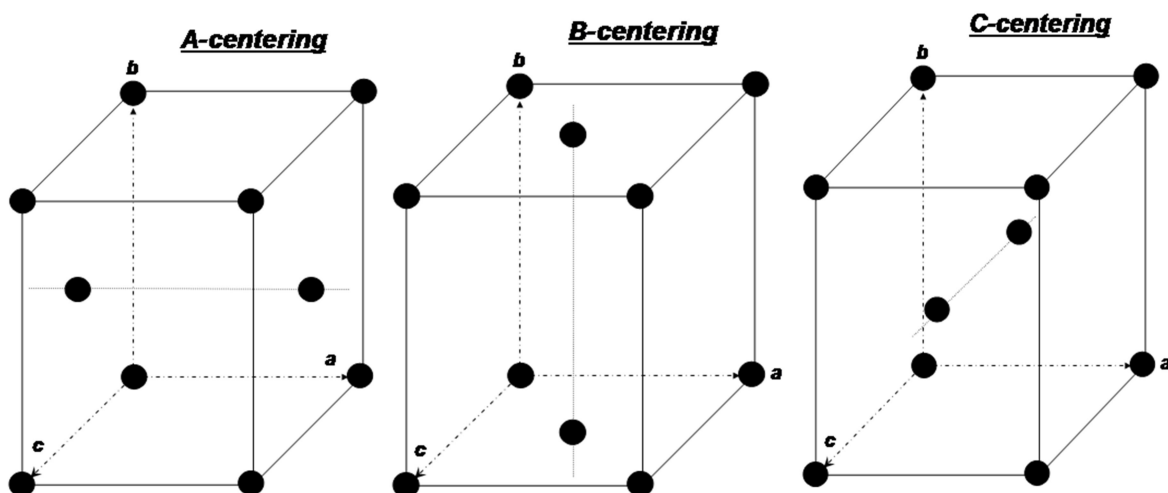


8. Homework 3D crystal system, 3D Bravais lattice, reciprocal lattice

1. The monoclinic crystal system (see Figure below) has following relationships between the lattice constants and corresponding angles: $a \neq b \neq c$ and $\alpha = \gamma = 90^\circ$, $\beta \neq 90^\circ$. In this lattice, a 2-fold symmetry axis is parallel and a mirror plane is perpendicular to the crystallographic b axis.

a) Why B-base-centered monoclinic lattice is not a special type of the Bravais lattice in contrast to the A- and C-base-centered Bravais lattices?



b) Why it doesn't make sense to define a base-centered cubic lattice as a special type of the Bravais lattice?

2.

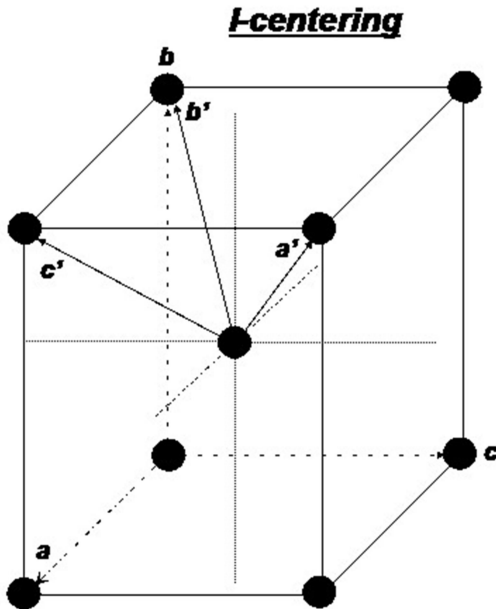
a) Prove that the two base-centered orthorhombic lattices, such as AB, BC or CA (A,B or C-base-centered shown in Figure above), are equivalent to an F-centered orthorhombic lattice.

b) Demonstrate that if $[0,1/2,1/2]$ and $[1/2,0,1/2]$ are the coordinates of the lattice points, then $[1/2,1/2,0]$ is a coordinate of the lattice point as well.

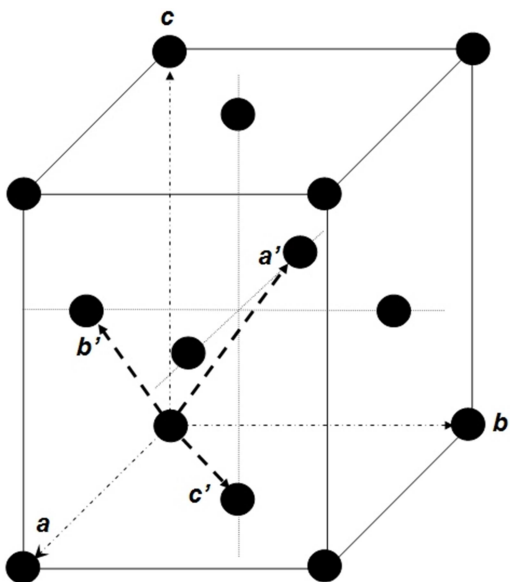
3. The body-centered cubic lattice is described by means of a non-primitive unit cell with the basis vectors \mathbf{a} , \mathbf{b} , \mathbf{c} or by a primitive unit cell with a triple \mathbf{a}' , \mathbf{b}' , \mathbf{c}' (see Figure below).

Find a ratio between the volumes of the non-primitive and primitive unit cells.

Define reciprocal lattice vectors \mathbf{a}^* , \mathbf{b}^* , \mathbf{c}^* for the body-centered cubic lattice.



4. The same task as for exercise 3 to be done for the face-centered cubic lattice (figure below)



Find a ratio between the volumes of the non-primitive and primitive unit cells.

Define reciprocal lattice vectors \mathbf{a}^* , \mathbf{b}^* , \mathbf{c}^* for the face-centered cubic lattice.