# Materials 218/UCSB: Assignment III


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1. The accompanying figure shows a two dimensional crystal structure formed by A, B, and C atoms.

   (a) What is the formula of the compound ?

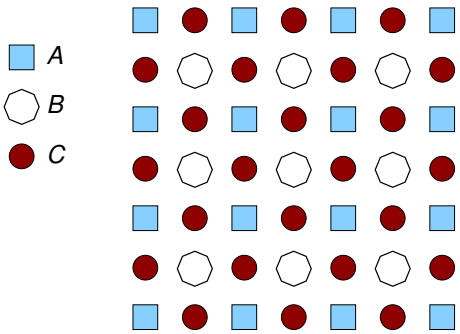
   (b) Identify the mirrors and rotation axes at the different atom sites.

   (c) Outline the unit cell.

   (d) What is the centering in the crystal ?

   (e) Can you suggest the name of the plane group.

   (f) Provide the complete minimal crystal structure description in terms of the plane group, cell parameters and the atom positions.




2. The compound OsAl has the following structure: SG = $Pm\bar{3}m$, $a$ = 3.00 Å , Os at (1/2, 1/2, 1/2) and Al at (0,0,0).

   (a) Sketch the structure as sections, and within a cube.

   (b) What is this structure type called ?

   (c) $OsAl_2$ is formed by successively stacking OsAl cubes, but every new stack is created from the old one by adding (1/2, 1/2, ≈1.5) Sketch $OsAl_2$ as sections after generating its coordinates. Is $OsAl_2$ cubic ? What are the cell parameters.

   (d) Can you guess the space group of $OsAl_2$ ?

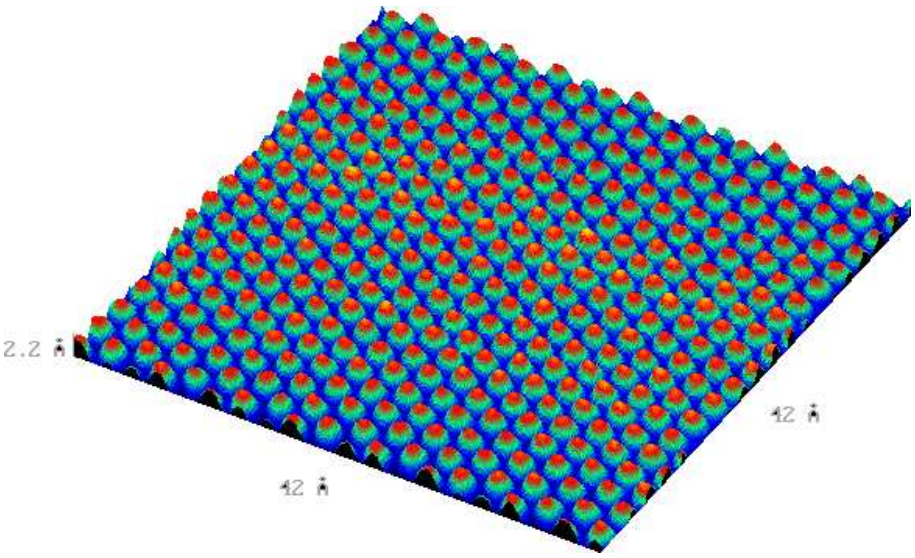
   (e) Can you guess how $Os_2Al_3$ is built up ?

3. Sketch the ideal perovskite $ABO_3$ struture with A atoms at the corners of the cell and the B atom in the middle. What are the coordinates of A, B and O ? Remember to provide the minimal, crystallographic description. How many nearest neighbors do A, B, and O each have ?

4. Sketch the perovskite structure as projections and then sketch the rock salt structure as projections. Compare the layers. Are there any structural relationships ? Show that the perovskite structure can be considered as alternate stackings of AO rock salt layers and $BO_2$ layers.

5. A compound is described with three kinds of atoms in the unit cell, A, B and C. A is in the Wyckoff position $2a$, (for the specific space group) B is in the Wyckoff position $8c$ and C in $24f$. What is the formula of the compound.

6. Given below is an STM image of the surface of a highly oriented graphite crystal. Given what you know about the graphite crystal structure, can you tell what the blimps are ? Are they atoms ?




The image is from `http://www.physics.louisville.edu/`

7. Carbon nanotubes are formed by rolling up single graphite sheets. Show using a suitable sketch that some carbon nanotubes can possess chiral[1] screw axes along the tube direction.

[1]Meaning that there are left and right handed versions such as the screws $6_1$ and $6_5$