PHYS 485 Materials Physics **Spring 2019**

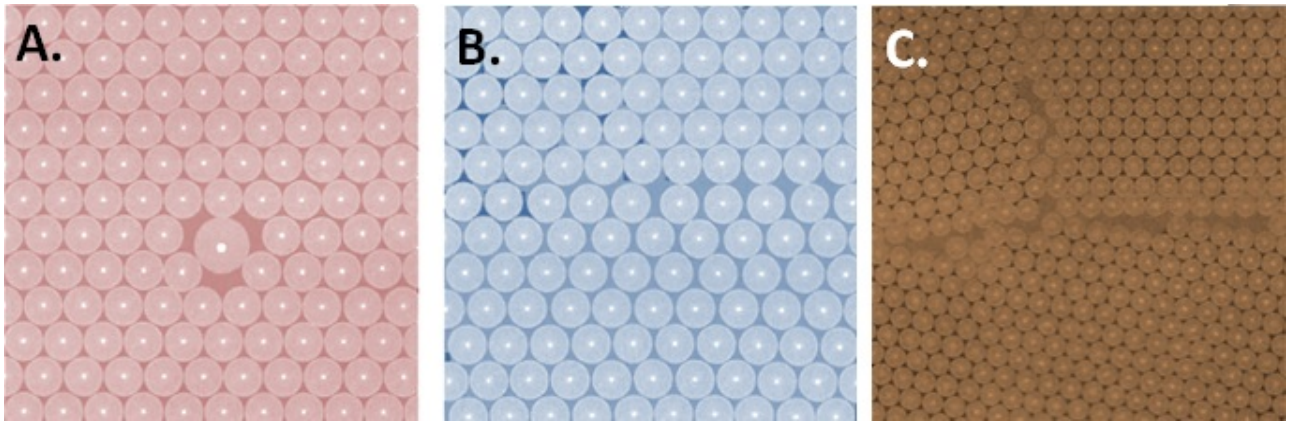
Homework 03

Read: Ch 3 & Ch 5

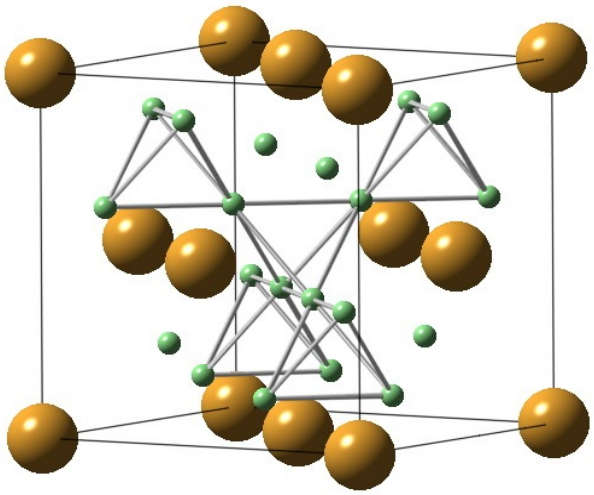
Due date: Friday, 22 Feb 19 by 11:59 PM

Work problems 2.3, 2.4, 2.5, 2.6, 2.7, 2.10, 2.12, 2.13, 2.14, 2.15, 2.16 in the text.

AQ 1: If the spheres in the pictures below represent the atoms in a crystal plane, which type of defect does each image reveal? Indicate the location of the defect on each image.



AQ 2: The diagram shows a cubic unit cell of the so-called C15 structure, which contains two species of atom ($MgCu_2$ takes on this structure).



(a) Is this a primitive cell?

(b) What is the Bravais lattice of this structure?

(c) How many atoms are there in this cell?

(d) If you consider only the larger atoms, what structure do they show?

(e) How many atoms are there in the basis?

(f) If the larger gold-colored atoms are of element A and the smaller green atoms are of element B, what is the chemical formula for the material?

>> See next page! <<

AQ 3: Suppose you have a single-crystal sample of the fictitious *anisotropic* mineral weirdite. The basis vectors for the unit cell of Weirdite are chosen to be parallel to the Cartesian unit vectors. The conductivity tensor for weirdite is given by:

$$\vec{\sigma} = \begin{pmatrix} 0 & 2 & 1 \\ 2 & 0 & 1 \\ 1 & 1 & 0 \end{pmatrix} (\Omega \cdot m)^{-1}$$

(a) You place your sample of weirdite in an external electric field that aligns with the $\vec{a}_1$ axis (*i.e.*, in the [100] direction): $\vec{E}_1 = \begin{pmatrix} E_1 \\ 0 \\ 0 \end{pmatrix}$. Use Ohm's law to determine the direction (give a unit vector) and magnitude of the current flowing in the crystal.

(b) Next you align the external electric field so that it points in the [011] direction. What are the direction (give a unit vector) and magnitude of the current flowing in the crystal?