

NORTHERN ILLINOIS UNIVERSITY

PHYSICS DEPARTMENT

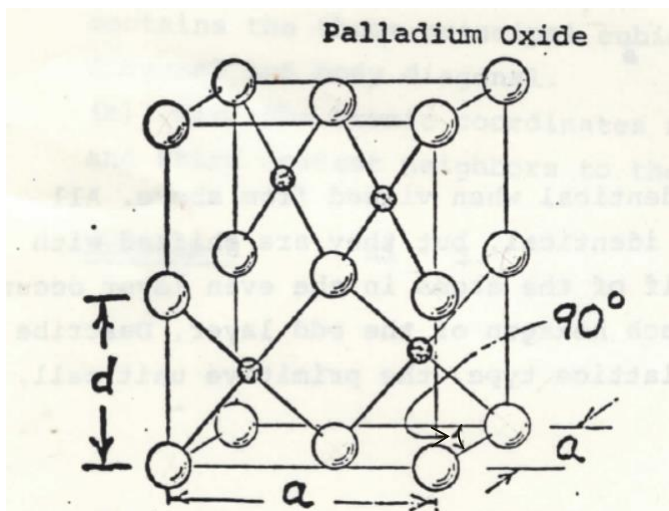
Physics 580 – Solid State Physics

Fall 2020

Problem Set #1

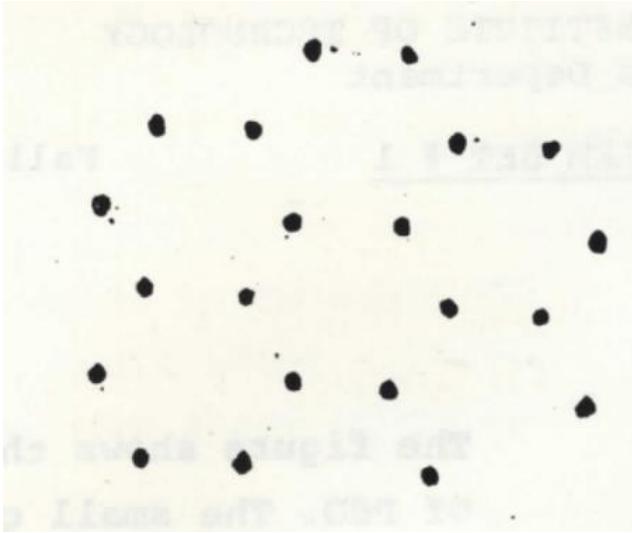
Problem Set Due: Thurs., Sept. 3, 2020

Read Kittel: Chapter 1



1. The figure shows the structure of PdO. The small circles represent palladium atoms and the large circles oxygen atoms. The PdO_4 groups are planar.
 - (a) What is the lattice type?
 - (b) Indicate the primitive unit cell, and give a set of primitive translation vectors.
 - (c) How many atoms are in a primitive unit cell? Give the coordinates of the basis atoms.
 - (d) Give the Miller indices for a plane which contains planar PdO_4 groups.
2. Calcium Fluorite, CaF_2 , has a structure based on the fcc lattice and a basis with Ca at $0\ 0\ 0$ and F's at $\frac{1}{4}\ \frac{1}{4}\ \frac{1}{4}$ and $\frac{3}{4}\ \frac{3}{4}\ \frac{3}{4}$. Draw a projection diagram and sketch one conventional (cubic) cell of the structure.

3. Graphite, a form of elemental carbon, is made up of planes of atoms. In each plane, the atoms are at the corners of open hexagons.



The odd-numbered layers are identical when viewed from above. All even numbered layers are also identical, but they are shifted with respect to the odd layers. Half of the atoms in the even layer occur exactly below the center of each hexagon of the odd layer. Describe this structure by giving the lattice type, the primitive unit cell, and the basis.

4. The diamond structure:

- (a) How many atoms are there in the primitive cell of diamond?
- (b) What is the length in angstroms of a primitive translation vector?
- (c) Show that the angle between the tetrahedral bonds of diamond is $109^{\circ}28'$.