**Chapter 3&4**

1. **Terms and Concepts: see summary of the chapters.**
2. **Understand the basic concepts: crystalline materials, space lattice, crystal structure, atomic hard sphere model, unit cell, lattice parameter.**

***Crystalline Materials:***A crystalline material is one in which the atoms are situated in a repeating or periodic array over large atomic distances.

***Space Lattice:***is an infinite,periodic array of mathematical points,which each point has identical surroundings to all others.

1. **What is the difference between space lattice and crystal structure?**
2. **What are the features of difference unit cell types?**
3. **What are the three typical metallic crystal structures (FCC, BCC, HCP)? How are the atoms**

**arranged in the unit cell? Which atoms are in touch with which atoms?**

1. **What is the definition of coordination number and atomic packing factor?**
2. **For SC, FCC, BCC, HCP, you need to know the relationship between lattice parameter and atomic radius, number of atoms per unit cell, coordination number, atomic packing factor, and close-packed direction (both geometrical direction and crystallographic direction).**
3. **Give some examples of metals exhibiting FCC, BCC, and HCP crystal structure. Table 4.1.**
4. **You need to be able to calculate theoretical density of a metal having FCC and BCC crystal structures given their unit cell dimensions. The equation will be provided if it is used in exam, but you need to know what each symbol means.**
5. **What are the names and features of the seven crystal systems?**
6. **How to determine crystallographic directions/planes? How is a crystallographic direction/plane described? You need to be able to write down indices for given direction vectors/planes, and label the direction vectors/planes for given indices.**
7. **For direction or plane indices, what do indices with opposite signs mean? (for directions, it means opposite directions; but for planes, it means the same plane but different faces).**
8. **What does direction family or plane family mean? How to describe families? You need to be able to write down directions or planes that contained in a specific family. Know exceptions in a crystallographic family in other crystal systems, such as in tetragonal systems.**
9. **Make sure you know the planes in a crystallographic family have the same atomic packing. You should be able to draw such planes in a unit cell. You should also be able to draw atomic packing for a given plane using hard sphere model.**
10. **Crystallographic directions and planes in HCP structure!!! Review the rules!!! Equation for 3-index system to 4-index system will be provided in exam.**
11. **Why some metals exhibit FCC crystal structure while some exhibit HCP crystal structure when their APF are all 0.74? What are the stacking sequences for FCC and HCP?**
12. **What are the features of a single crystal? Where are single crystals used?**
13. **The concept of grain, crystallization, polycrystalline materials, and grain boundary.**
14. **What are the two steps for crystallization? → Nucleation, growth.**
15. **The concept of anisotropy, isotropic materials, and texture.**
16. **What technique is used to determine the crystal structure of a material? What equation is this technique based on?**
17. **Understand the concept of ionic character. What does higher ionic character percentage mean?**
18. **What are the two factors that influence the crystal structure of ceramic materials? How do the two factors have effects on the crystal structure?**
19. **Sketch and describe unit cells for sodium chloride, cesium chloride, zinc blende, fluorite, and perovskite crystal structure. Do likewise for the atomic structures of graphite and a silica glass.**
20. **Given the chemical formula for a ceramic compound, the ionic radii of its component ions, determine the crystal structure.**
21. **Density computation for ceramics.**
22. **Understand the concept of amorphous materials, polymorphism, and allotropy.**
23. **Understand what tetrahedral and octahedral positions are.**
24. **Please also review the lecture note handouts written in Chinese, such as the calculation of interstitial radius, etc.**