

LEARNING OBJECTIVES
CHAPTER 4 - IMPERFECTIONS IN SOLIDS

1. Describe both vacancy and self-interstitial crystalline defects.
2. Given the density and atomic weight for some material, as well as Avogadro's number, compute the number of atomic sites per cubic meter
3. For some material, given the number of atomic sites per cubic meter, the energy required for vacancy formation, and, in addition, the value for the gas constant, compute the number of vacancies at some specified temperature.
4. Define what is meant by the term "alloy."
5. State the two types of solid solutions, and provide a brief written definition and/or schematic diagram of each.
6. State the criteria for the formation of each of substitutional and interstitial solid solutions.
7. Given the atomic radii of host and impurity atoms, as well as their crystal structures, electronegativities, and valences, determine if solid solutions that form are (a) substitutional with appreciable solubility, (b) substitutional with limited solubility, or (c) interstitial.
8. Given the masses and atomic weights of two or more elements in a metal alloy, compute the weight percent and atomic percent of each element.
9. (a) Given the composition (in weight percent) and atomic weights for two elements in an alloy, determine the composition in atom percent.
(b) Make a composition conversion from atom percent to weight percent.
10. Given the atomic weights and densities for two elements in an alloy:
(a) Determine the average density when the composition is specified in weight percent.
(b) Determine the average density when the composition is specified in atom percent.
11. Given the atomic weight for each of two elements in an alloy:
(a) Determine the average atomic weight when the composition is specified in weight percent.
(b) Determine the average atomic weight when the composition is specified in atom percent.
12. For each of edge, screw, and mixed dislocations:
(a) describe and make a drawing of the dislocation;
(b) note the location of the dislocation line; and
(c) indicate the direction along which the dislocation line extends.

13. (a) Describe the atomic structure within the vicinity of a grain boundary.
(b) Make a distinction between high- and small-angle grain boundaries.
(c) Explain how a small-angle tilt boundary is formed by an array of edge dislocations.
14. Describe the arrangement of atoms in the vicinity of a twin boundary.
15. Define the terms *microstructure* and *microscopy*.
16. Explain what preparations are necessary for observation of the grain structure of a polycrystalline material with an optical microscope.
17. Name and briefly describe the operations of each of the two types of electron microscopes.
18. In general terms, briefly explain how scanning probe microscopes operate.
19. Given a photomicrograph of a polycrystalline material, as well as the magnification, determine the grain size using intercept and ASTM methods.