

Chapter 3

Structure of Solids

Overview

Solids are characterized first of all by the fact that atoms have fixed positions with respect to their neighbors. In addition, many solids are found most commonly in crystalline form, which means that atoms are arranged in a regular pattern that repeats itself over many thousands, even millions, of interatomic distances. The simplest and most prevalent types of solids involve ordered arrays of atoms with a cubic or hexagonal symmetry. The order of a solid structure can be determined by such methods as X-ray crystallography. We will examine some important examples of crystalline metals, ceramics, and covalent solids, and compare them to polymers and inorganic glasses with more or less random structure. The profound influence of structure on the properties of solids will become apparent.

After studying this chapter, you will be able to :

1. Distinguish simple cubic, face-centered cubic, body-centered cubic, and hexagonal close-packed crystal structures in terms of their unit cells;
2. Describe how structures of metals, ceramics, covalent crystals, inorganic glasses, and polymers differ, and are determined by their interatomic bonding;
3. Determine simple metal and ceramic crystal structures from their X-ray diffraction patterns;
4. Recognize the capabilities of diffraction methods for the analysis of small particles, amorphous materials, and surfaces;
5. Relate materials types and their structures to a few important materials properties.