

Chapter 4

Defects in Solids

Overview

Most solid engineering materials are polycrystalline or amorphous, rather than single crystals. This means that they contain various types of imperfections, or defects, which disturb the regular crystalline array of atoms. Different types of defects can be distinguished. Structural imperfections may be confined to individual lattice sites, or they may occur along lines or even planes of atoms. Also, engineering materials often are not pure but may contain isolated impurities or, in the case of an alloy, may be composed of comparable amounts of two or more elements. The proper control of such imperfections in a material allows an engineer to tailor the material properties to a specific purpose or application.

After studying this chapter, you will be able to :

1. Distinguish the different types of lattice imperfections: point defects (vacancies, substitutional and interstitial impurities), line defects (dislocations), and area defects (grain boundaries);
2. Analyze the thermodynamics of point defects in metals;
3. Describe metal alloys as solid solutions according to the Hume-Rothery rules;
4. Describe edge and screw dislocations in terms of their atomic configuration and their Burgers vector;
5. Outline the main types and properties of lattice imperfections in ceramics and how they differ from those in metals;
6. Discuss the most basic aspects of defects in covalent crystals and amorphous materials.