

Chapter 7

Phase Changes

Overview

A material of a given composition can exist in several different forms called phases. The simplest example would be an element, where these phases comprise the material as a solid, as a liquid, or as a gas. Certain materials may exist in several solid phases which differ only in their crystal structure. The nature of these phases depends on the number of components making up the material, i.e. on the number of its basic building blocks. The simplest case is a one-component system, such as an element, H_2O , or CO_2 . Temperature and pressure determine which of the possible phases is thermodynamically stable. Under special conditions, in a one-component system two or even three phases can coexist, as one phase is transformed into another. The transformation of primary interest is the one involving melting/solidification, especially as it applies to crystalline and amorphous materials.

After studying this chapter, you will be able to :

1. Describe what a phase of a material is and give pertinent examples;
2. Define components, phases, and degrees of freedom of a material system;
3. Draw a one-component phase diagram and explain its various parts and regions;
4. Use a one-component phase diagram to determine the phases present at a specified temperature and pressure;
5. Relate phase diagrams to the Gibbs Phase Rule;
6. Explain melting and solidification in terms of the nucleation and growth of a new phase;
7. Outline the differences between crystalline and amorphous materials in melting and solidification.