Introduction

Materials science includes the development and study of the properties of materials for one purpose. Apart from a few special cases, metals are rarely used industrially in their pure state. Generally, alloys consist of two elements (binary alloys), three elements (ternary alloys), etc. The alloys are composed of one phase (single-phase alloys) or several phases (polyphase alloys). A phase (solid solution) can be defined as a homogeneous part of the material having its own chemical composition and structure.

These phases can undergo transformations during the use of the materials, which are based on the diffusion phenomenon. These phase changes are given by equilibrium diagrams (or phase diagrams). Any phase transformation leads to a reduction in the free enthalpy of the system (the thermodynamic principle for reaching equilibrium), which can only begin from the germs of the new phase. These germs grow to eventually form an equilibrium phase. So in all phase transformations, we observe the two phenomena of germination and growth.

The phase transformation mechanisms obey Avrami's law, which gives the variation of the germination rate as a function of time at a constant temperature. For different curves, we can obtain the T.T.T. diagram (transformation-temperature-time) and describe the phase transformation as a function of time.

In these chapters, students will learn the fundamental thermodynamic, crystallographic, and kinetic rules of phase changes in materials. Practical examples have been used to illustrate transformations that have been deemed essential from the perspective of engineering. Each chapter should be thoroughly studied by students in order to:

- Based on the thermodynamic, crystallographic, and kinetic features, distinguish between the fundamental types of changes in engineering materials,
- Propose a realistic explanation for the phase changes that might occur under specific circumstances during the technological processing of metallic materials,
- Identify the fundamental engineering materials transformation products.

The books provided in the reference list at the end of this document can be used to find any additional information.

This document is intended for Master I students of Frères Mentouri_Constantine 1 University; it is also suitable for any students from various fields of study, provided they comply with the essential pre-requisites for enrolling in this course: completion of material sciences, structure and properties of solids, and heat treatment essentials. The recommended method for approaching each chapter is to read the text section attentively and then do the exercises provided.

At the end of this document, I propose a trilingual glossary that constitutes a basic tool for Master students in physics, in particular materials sciences. Its objective is above all educational; it can initially relieve the difficulty of finding, in the field, a bibliography in Arabic. It brings together the majority of terms used in this manuscript.