

Chapter 9

Metal Alloys

Overview

Metals are generally used in the form of alloys in structural applications. This is due to the fact that alloying, in connection with suitable heat treatments, allows for a great deal of control over the alloy microstructure and mechanical properties, in particular tensile and yield strength vs. ductility and toughness. In this chapter a brief overview of these issues will be given for Fe-, Cu- and Al-based commercially important alloys. The focus will be on various alloying elements and their effects on phase diagrams and microstructures, and ultimately on mechanical properties.

After studying this chapter, you will be able to :

1. Name the main alloying elements for Fe-, Cu-, and Al- alloys and describe how they interact with the respective base materials;
2. Describe how alloying elements affect the phase diagram and the phase transformation kinetics of the pure materials;
3. Describe how these alloying effects change the microstructure relative to the pure material;
4. Outline how the microstructure can be controlled through alloying and suitable heat treatment;
5. Describe how the composition and microstructure of an alloy determine its mechanical properties;
6. List some major uses and applications of the various alloys.