

# Chapter 6

## Diffusion

### Overview

Diffusion is a high-temperature process by which atoms in a solid can move about and redistribute themselves. At sufficiently high temperature, atoms vibrate so strongly about their equilibrium positions that occasionally they are able to jump to a neighboring site. This type of step-by-step atom motion, when combined with local differences in atom concentrations, gives rise to mass transport over macroscopic distances. Two situations are of particular importance: 1) Steady-state or, equivalently, time-independent diffusion, where atoms move without changing the overall concentrations; and 2) Non-steady-state diffusion, where atom concentrations in the sample change with time. The diffusion process depends strongly on temperature and on the material and its microstructure. It is especially useful for controlling the distribution of impurities and other defects in solids.

**After studying this chapter, you will be able to :**

1. Describe the process of diffusion as a means of mass transport in a material;
2. Define and use the macroscopic parameters characterizing diffusion;
3. Connect the diffusion parameters to relevant processes at the atomic level;
4. Recognize the two experimental conditions most important for diffusion in solids: steady-state and non steady-state diffusion;
5. Analyze both conditions with respect to atom fluxes and changes in atom concentrations;
6. Determine the effect of temperature on diffusion parameters and the outcome of the overall process.