CHAPTER 5

5.13 *Determine the carburizing time necessary to achieve a carbon concentration of 0.45 wt% at a position 2 mm into an iron–carbon alloy that initially contains 0.20 wt% C. The surface concentration is to be maintained at 1.30 wt% C, and the treatment is to be conducted at 1000°C. Use the diffusion data for γ-Fe in Table 5.2.*

5.15 *Nitrogen from a gaseous phase is to be diffused into pure iron at 700°C. If the surface concentration is maintained at 0.1 wt% N, what will be the concentration 1 mm from the surface after 10 h? The diffusion coefficient for nitrogen in iron at 700°C is* 2.5×10^{-11} m^2/s.

5.24 *The diffusion coefficients for silver in copper are given at two temperatures are as follows:*

T (°C)	*D* (m^2/s)
650	5.5×10^{-16}
900	1.3×10^{-13}

(a) Determine the values of D_0 *and* Q_d.

(b) What is the magnitude of D at 875°C?

5.34 *Phosphorous atoms are to be diffused into a silicon wafer using both predeposition and drive-in heat treatments; the background concentration of Sb in this silicon material is known to be* 5×10^{19} $atoms/m^3$. *The predeposition treatment is to be conducted at 950°C for 45 minutes; the surface concentration of P is to be maintained at a constant level of* 1.5×10^{26} $atoms/m^3$. *Drive-in diffusion will be carried out at 1200°C for a period of 2.5 h. For the diffusion of P in Si, values of* Q_d *and* D_0 *are 3.40 eV and* 1.1×10^{-4} m^2/s, *respectively.*

(a) Calculate the value of Q_0.

(b) Determine the value of x_j *for the drive-in diffusion treatment.*

(c) Also, for the drive-in treatment, compute the position x at which the concentration of P atoms is $10^{24}/m^3$.