M-Tech, Øving 2 Vegard G. Jervell

Oppg. 1)

$T = 1173\,K \quad D = 1{,}2 \cdot 10^{-10}\ m^2/s \quad J = 10^{-7}\ \frac{kg}{m^2 s}$

$C_0 = 2\ kg/m^3 \quad C_1 = 0{,}5\ \frac{kg}{m^3}$

$J = D\frac{\partial C}{\partial x} \rightarrow \partial x = \frac{D \partial C}{J}$

$\partial x = 1{,}8\,mm$ inn i platen

Oppg. 2)

$\frac{\partial^2 C}{\partial x^2} = D\frac{\partial C}{\partial t}$, $C_s = 0{,}9\ wt\%$, $C_0 = 0{,}1\ wt\%$

$T = 1273\,K \quad C(x,t) = 0{,}3\ wt\% \ , \ x = 4\,mm$

$\frac{C(x,t) - C_0}{C_s - C_0} = 1 - erf\left(\frac{x}{2\sqrt{Dt}}\right)$, antar $l < 10\sqrt{Dt}$

$erf\left(\frac{x}{2\sqrt{Dt}}\right) = 1 - \frac{0{,}3 - 0{,}1}{0{,}9 - 0{,}1} = 0{,}75$

$\frac{x}{2\sqrt{Dt}} \approx 0{,}8$

$t = D^{-1}\left(\frac{x}{2 \cdot 0{,}8}\right)^2$, $D = D_0 \exp\left(\frac{-Q_A}{RT}\right) = 1{,}9 \cdot 10^{-11}$

$t = 91{,}4$ timer

Oppg 3a)

$$D_{Al}(623K) = D_0 \exp\left(\frac{-Q_A}{RT}\right) = 4{,}11 \cdot 10^{-14}$$

Oppg 3b)

diffusjonsresultat er en funksjon av $\text{erf}\left(\frac{x}{2\sqrt{Dt}}\right)$. Vil finne:

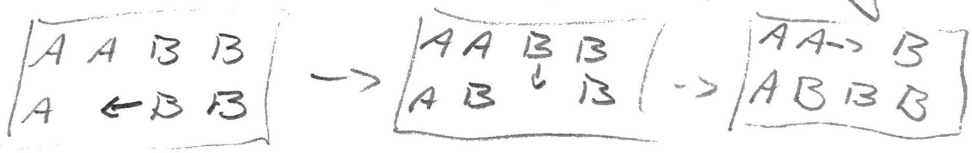
$$\left\{t > 0 \,\middle|\, \frac{x}{2\sqrt{D(450°C)\cdot 15h}} = \frac{x}{2\sqrt{D(550°C)\cdot t}}\right\}$$

$$D(450°C)\cdot 15h = 2{,}2 \cdot 10^{-9}$$

$$t = \frac{2{,}2 \cdot 10^{-9}}{D(550°C)} = 1 \text{ time}$$

Oppgave 4a) Vakansdiffusjon:

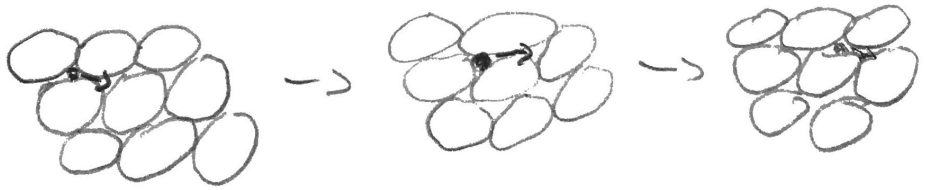
Vakanser flytter på seg



osv.

Interstitiell diffusjon:

Atomer på interstitiell plass flytter seg fra "hull til hull"



osv.

Denne er generelt raskere

Aufg. 4b)

$C_0 = 10^{-4}$ Gew.%, $T = 900\,^\circ C$

$C_S = 0{,}1$ Gew.%, $C(x,t) = 0{,}01$ Gew.%, $x = ?$

$D(900\,^\circ C) = 10^{-12}\ m^2/s$

$$\frac{C(x,t) - C_0}{C_S - C_0} = 1 - \mathrm{erf}\left(\frac{x}{2\sqrt{Dt}}\right)$$

$$\mathrm{erf}\left(\frac{x}{2\sqrt{Dt}}\right) = 0{,}9$$

$$\frac{x}{2\sqrt{Dt}} \approx 1{,}2$$

$$t = D^{-1}\left(\frac{x}{2{,}4}\right)^2$$

$$t = 30\ min$$