2021214S 재료치 HW7.

a) regular solution behavior 일때,

$$G_m = X_A{}^\circ G_A + X_B{}^\circ G_B + RT(X_A \ln X_A + X_B \ln X_B) + X_A X_B \Omega$$

$\frac{\partial \Delta G_m}{\partial X_A} = 0$, $\frac{\partial \Delta G_m}{\partial X_B} = 0$ 이 T

$$RT\left(1 + \ln X_A\right) + X_B \Omega = 0 \qquad RT\left(2 + \ln X_A X_B\right) + \Omega = 0$$

$$RT\left(1 + \ln X_B\right) + X_A \Omega = 0 \qquad T = \frac{-\Omega}{(2 + \ln X_A X_B)R}$$

b) $\left.\frac{\partial^2 G}{\partial C^2}\right)_{P,T} = 0$: spinodal

c) $$\lambda = \left[- \frac{8\pi k}{f''(C_0) + \frac{2E\eta^2}{1-\nu}} \right]^{\frac{1}{2}}$$

$$f(C) = G_m / V_m$$

$$f''(C) = \frac{d^2 G_m / V_m}{dx^2}$$

d) $\lambda_m = \sqrt{2}\lambda_c$

e) $$R(\beta) = -M\left[f''(C_0) + \frac{2E\eta^2}{1-\nu}\right]\beta^2 - 2kM\beta^4$$

$$\left.\frac{\partial R}{\partial \beta}\right|_{\beta=\beta_m} = 0 \qquad \beta = \frac{2\pi}{\lambda}$$

$$\beta_m^2 = -\frac{1}{4k}\left[f'' + \frac{2E\eta^2}{1-\nu}\right] = \frac{\beta_c^2}{2}$$

$$R_{max} = R(\beta = \beta_m) = \frac{1}{2}kM\beta_c^4 = \frac{1}{2}kM\left(\frac{2\pi}{\lambda_c}\right)^4$$

2. (a) $RT : 25°C = 298.15\,K$

$D_A = 10^{-4}\exp(-85000/8.314\times298.15)\ m^2/s$

$= 1.282\times10^{-19}\ m^2/s$

i) $t : 10s$ $\quad C_A(x,t) = C_A(x,0)\exp(-\pi^2\times1.282\times10^{-19}\times10/(0.01\times10^{-6})^2)$

$= 0.881\,C_A(x,0)$

ii) $t : 100s$ $\quad C_A(x,t) = C_A(x,0)\exp(-\pi^2\times1.282\times10^{-19}\times100/(0.01\times10^{-6})^2)$

$= 0.282\,C_A(x,0)$

transformation time이 증가하면 maximum concentration $C_A(x,t)$가 감소한다.

(b) i) $\lambda : 0.1\mu m$

$C_A(x,t) = C_A(x,0)\exp(-\pi^2\times1.282\times10^{-19}\times100/(0.1\times10^{-6})^2)$

$= 0.987\ C_A(x,0)$

ii) $\lambda : 0.01\mu m$

$C_A(x,t) = 0.282\,C_A(x,0)$

wavelength가 길어지면 maximum concentration은 증가한다.

(c) i) at RT

$C_A(x,t) = 0.282\,C_A(x,0)$

ii) at 100K above RT

$T = 398.15\,K$

$D_A = 10^{-4}\exp(-85000/8.314\times398.15)\ m^2/s$

$= 7.050\times10^{-16}$

$C_A(x,t) = C_A(x,0)\exp(-\pi^2\times7.050\times10^{-16}\times100/(0.01\times10^{-6})^2)$

$= 0$

T가 증가하면 maximum concentration은 0에 수렴한다.

(d) T가 증가하면 D_A증가 폭이 커져 가장 변화가 커진다.

따라서 온도가 가장 sensitive하다