Phase Transformation HW 7. 2020238 권소혜

1. $C(x,t) = 38 + 12 \cdot \exp(R(\beta)t) \cos \beta x$.

$$\frac{\partial c}{\partial t} = 12 \exp(R(\beta)t) \cdot R(\beta) \cdot \cos \beta x \qquad * \ \beta = \frac{2\pi}{\lambda} = 10^9 \times \pi \ m^{-1}$$

$$\frac{\partial^2 c}{\partial x^2} = -12 \exp(R(\beta)t) \cdot \beta^2 \cos \beta x.$$

Maximum difference ≤ 2 at% Au 되기위한 t :

$$\exp(R(\beta)t) \leq \frac{1}{12} \ \rightarrow \ t = -\ln 12 \cdot \frac{1}{R(\beta)}$$

a) $\frac{\partial c}{\partial t} = \tilde{D} \frac{\partial^2 c}{\partial x^2}$: $R(\beta) = -\tilde{D} \cdot \beta^2 \rightarrow t = \ln 12 \cdot \frac{1}{\tilde{D} \cdot \beta^2}$

$$\therefore t = \ln 12 \times \frac{1}{(10^{-23} m^2/s) \times (10^9 \times \pi \ m^{-1})^2} = \frac{\ln 12}{\pi^2} \cdot 10^5 s \fallingdotseq 251775$$

b) $\frac{\partial^4 c}{\partial x^4} = 12 \exp(R(\beta)t) \cdot \beta^4 \cos \beta x$

$$R(\beta) = -\tilde{D}\beta^2\left(1 + \frac{2K}{f''}\beta^2\right) \rightarrow t = \ln 12 \cdot \frac{1}{\tilde{D} \cdot \beta^2 \left(1 + \frac{2K}{f''}\beta^2\right)}$$

$$\therefore t = \ln 12 \cdot \left((10^{-23} m^2/s)(10^9 \cdot \pi \cdot m^{-1})^2 \left(1 + \frac{2 \times (-2.6 \times 10^{-11} J \cdot m^{-1})}{5 \times 10^9 J \cdot m^{-3}} (10^9 \cdot \pi \ m^{-1})^2 \right) \right)^{-1}$$

$$= \ln 12 \cdot \left((10^{-5} \cdot \pi^2 / s) \cdot (1 + -1.04 \times 10^{-2} \times \pi^2) \right)^{-1} = 28057 s$$

c) Ag-Au system은 다른 원자와 결합을 선호하고 negative gradient E coefficient를 가지기에 spinodal decomposition을 덜 선호한다.

(a)보다 (b)의 식에서 더 오랜 시간이 걸렸으며, 이 식이 더 적절하다.