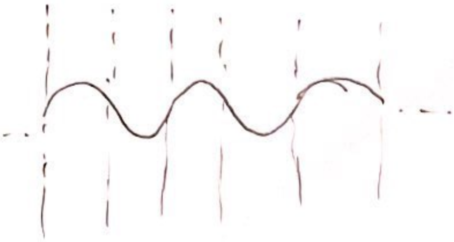
상변태론 Problem 7. 2020[illegible] 권지섭

1.

The initial condition of multi film system is



$$C(x,0) = (38\ at\%\ Au) + (12\ at\%\ Au)\cos\beta x$$

As time spent the concentration function is written as.

$$C(x,t) = (38\ at\%\ Au) + (12\ at\%\ Au)\exp[R(\beta)t]\cos\beta x$$

a) Using the Fick's second law. the left side is written. as

$$\frac{\partial C}{\partial t} = 12\,R(\beta)\exp[R(\beta)t]\cos\beta x.$$

the right side is

$$\tilde{D}\frac{\partial^2 C}{\partial x^2} = -12\,\tilde{D}\beta^2\exp[R(\beta)t]\cos\beta x$$

Fick second law suggest these two terms are same.

$$12\,R(\beta)\exp[R(\beta)t]\cos\beta x = -12\,\tilde{D}\beta^2\exp[R(\beta)t]\cos\beta x$$

$$\therefore\ R(\beta) = -\tilde{D}\beta^2 = -10^{-23}\cdot\left(\frac{2\pi}{2\times10^{-9}}\right)^2 = -9.86\times10^{-5}/\text{sec}$$

Since the amplitude of the wave is 1% from the given condition (difference: 2%)

$$39 = 38 + 12\exp(-9.86\times10^{-5}t) \qquad \therefore\ t = 25200\ \text{sec}$$

b) Cahn's law suggest

$$\frac{\partial C}{\partial t} = 12\,R(\beta)\exp[R(\beta)t]\cos\beta x$$

$$\tilde{D}\frac{\partial^2 C}{\partial x^2} - \frac{2K\tilde{D}}{f''}\frac{\partial^4 C}{\partial x^4} = \left(-\tilde{D}B - \frac{2K\tilde{D}}{f''}\cdot\beta^4\right)\cdot 12\exp[R(\beta)t]\cos\beta x$$

$$R(\beta) = -\tilde{D}\beta^2 - \frac{2K\tilde{D}}{f''}\beta^4 = -1.08\times10^{-4}/\text{sec}$$

same as 1. a)

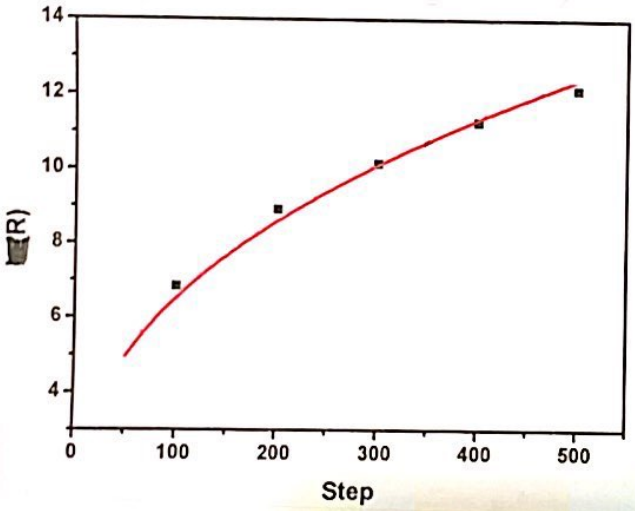
$$39 = 38 + 12\exp(-1.08\times10^{-4}\cdot t) \qquad t = 23008\ \text{sec}$$

c) Ag and Au favors the ordering which means that uphill diffusion (Spinodal decomposition) is unfavored. Spinodal decomposition occur as the amplitude increase as time flow. which means the $R(\lambda)$ value in the exponential term has positive value

In 1. a) and 1. b) case the absolute value of $\frac{2kT}{f''}\rho^4$ is very small since the second term of 1. b) can't have major effect on the result.

2.

a)



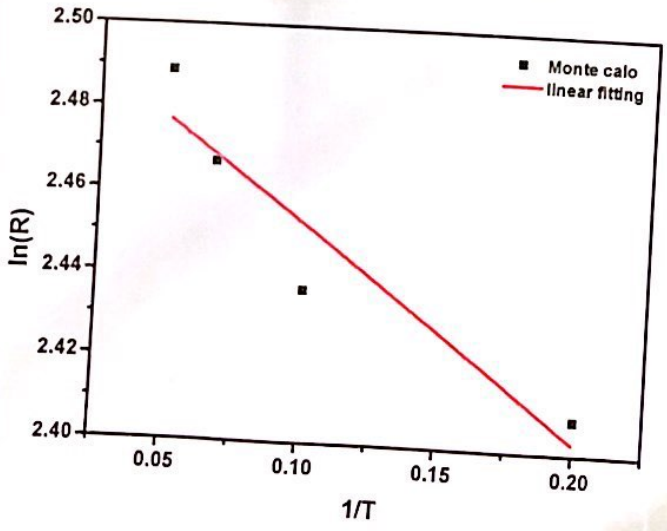
This simulation contain use less grain ~~size~~ number 5/4000 and saved the data with 100 step in given temperature of 20.

I used polynomial $R = k \cdot t^n$

we get the value $n \approx 0.4 \simeq 0.5$

So I assume ~~the parabolic growth law~~

b)



Same grain number with 2-a)

Since the growth growth is related to diffusion, I plot the data in Arrhenius plot.

Calculated slope is -0.4926.

Grain growth itself is not the function of only diffusion. So I assume we didn't get perfect linear plot.