HW 7.

1. (a) $\frac{\partial C}{\partial t} = 12 R(\beta) \exp(R(\beta)t) \cos\beta x$.

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

$$\frac{\partial C}{\partial t} = \tilde{D} \frac{\partial^2 C}{\partial x^2}$$

$$R(\beta) = -\tilde{D}\beta^2 = -10^{-23}\left(\frac{2\pi}{2\times10^{-9}}\right)^2$$

$$= -9.86\times10^{-5}/s$$ (R is negative)

time that maximum composition difference is 2at%, t_1

$$C(0, t_1) = 39$$

$$= 38 + 12\exp(-9.86\times10^{-5}\cdot t_1)$$

$$t_1 = 25201 \text{ sec.}$$

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

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

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

$$C(0, t_1) = 39 + 12\exp(-1.08\times10^{-4} t_1) = 39$$

$$t_1 = 23008 \text{ sec.}$$

(c) ($\Delta H_{mix} < 0$) means there is no spinodal decomposition for Ag and Au.

ΔH_{mix} can be expressed as $\Omega X_A X_B$.

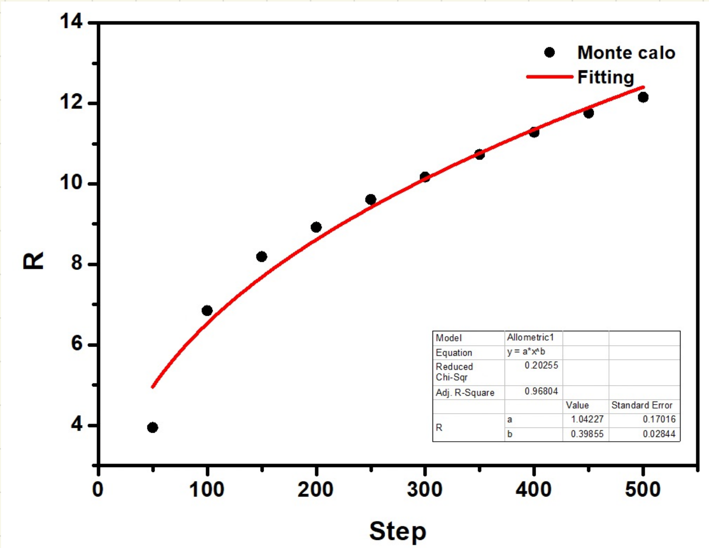
$\rightarrow \Omega < 0$ in this case.

$\frac{d^2 \Delta G}{d X_{Ag}^2} \geq 0$, when $\Delta G_{mix} = \Omega X_A (1 - X_A) - RT \ln X_A - RT \ln X_B$

So, $\left(- \frac{2K\tilde{D}}{f''} \cdot \frac{\partial^4 C}{\partial x^4} \right)$ term in (b) is not important because fluctuation is getting smaller..

This means, there is no big difference in t, each case.

2. (a) Simulation.



Grain : 514000

Step : 500

Save per 50 step.

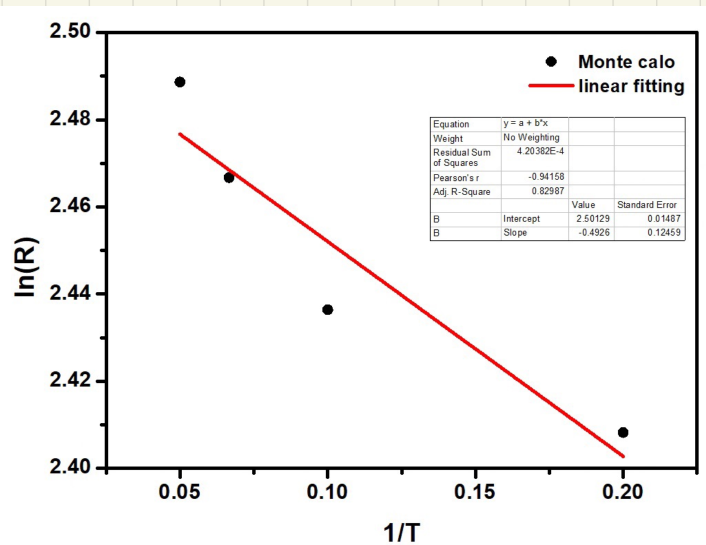
Tem : 20

$R = Kt^n$

$K = 1.04$

$n = 0.3986 \simeq 0.4$.

(b)



Grain : 514000

Step : 500.

Save per 500 step.

tem : 5, 10, 15, 20

$$R = Kt^n$$

$$= K_0 \exp\left(-\frac{Q}{kT}\right) \cdot t^n$$

$$\ln R = \ln K_0 t^n - \frac{Q}{k} \cdot \frac{1}{T}$$

$$b = \frac{Q}{k} = -0.4926$$