1.

(a)

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

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

$$\frac{\partial C}{\partial t} = \tilde{D} \frac{\partial^2 C}{\partial x^2} \Rightarrow R(\beta) = -\tilde{D}\beta^2 = -10^{-23} \cdot \left(\frac{2\pi}{2\times10^{-9}}\right)^2 = -9.86\times10^{-5}/s$$

At the time that maximum composition difference is 2at% Au,

t_1, $C(0,t_1) = 39$ at% $= 38 + 12\exp(-9.86\times10^{-5} \cdot t_1) = 39$

$t_1 = 25201$ sec.

(b)

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

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

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

$$C(0,t_1) = 39 = 38 + 12\exp(-1.08\times10^{-4} t_1) = 39.$$

$t_1 = ~~23201~~$ 23008 sec

(C) Since ΔH_{mix} for Ag and Au is negative, spinodal decomposition is unfavorable. ΔH_{mix} can be expressed as $\Omega X_A X_B$, and $\Omega < 0$ for this case. so, $\frac{d^2 \Delta G}{d X_{Ag}^2} \geq 0$ where $\Delta G_{mix} = \Omega X_A(1-X_A) - RT\ln X_A - RT\ln X_B$ in every composition.

Then small fluctuation will not become larger.

In this aspect, $-\frac{2k\tilde{D}}{f''}\frac{\partial^4 c}{\partial x^4}$ term (concerning fluctuation term) is not important anymore.

$\Rightarrow$ answer of (a) and answer of (b) doesn't have ~~sign~~ significant difference.

2.

(a) with simulation condition,

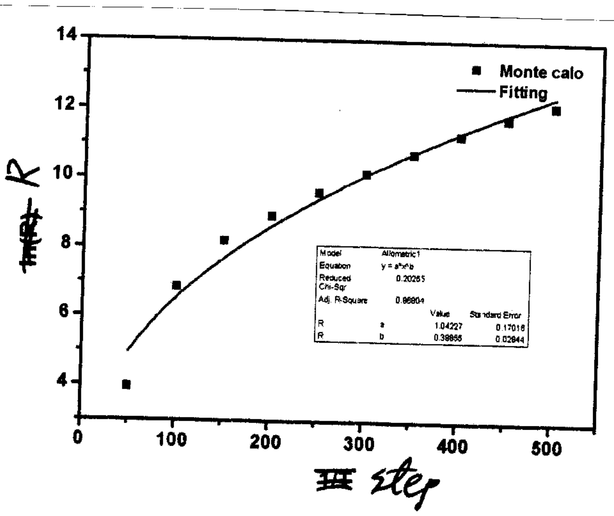
grain : 514000

step : 500

save per 50 step

temperature : 20.

$\Rightarrow$



$R = kt^n$, we can use fitting equation $y = ax^b$

result : $a = 1.04$, $b = 0.39 \approx 0.4$

(b) with simulation condition

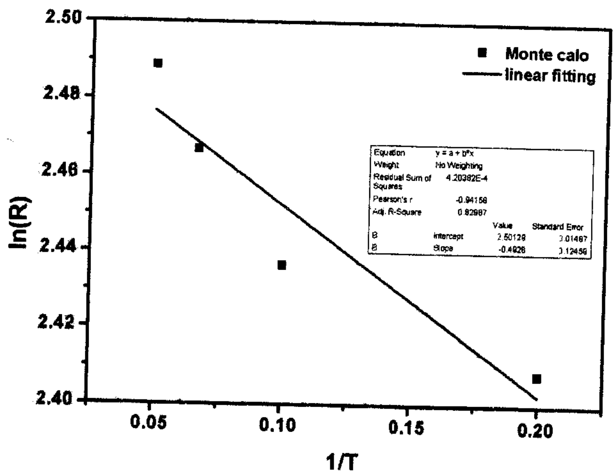
grain : 514000

step : 500

save per 500 step

temperature : 5, 10, 15, 20

$\Rightarrow$



we can use $R = kt^n = k_0 \exp\left(-\frac{Q}{kT}\right) \cdot t^n$

t^n is constant in this case. $\Rightarrow \ln R = \ln k_0 t^n - \frac{Q}{k} \cdot \frac{1}{T}$

fitting eq : $y = a + bx$

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