1. (a).

$$C(x,0) = (38\text{ at\% An}) + (12\text{ at\% An})\cos\beta x.$$

$$C(x,t) = (38\text{ at\% An}) + (12\text{ at\% An})\exp[B(\beta)t]\cos\beta x.$$

$$\frac{dC}{dt} = (12\text{ at\% An})\cdot B(\beta)\cdot\exp[B(\beta)\cdot t]\cos\beta x$$

$$\frac{d^2C}{dx^2} = -\beta^2(12\text{ at\% An})\exp[B(\beta)\cdot t]\cos\beta x.$$

$$\Rightarrow \frac{dC}{dt} = \tilde{D}\frac{d^2C}{dx^2}$$

$$: (12\text{ at\% An})\cdot B(\beta)\exp[B(\beta)t]\cos\beta x = -\tilde{D}\beta^2(12\text{ at\% An})\exp[B(\beta)t]\cos\beta x$$

$$\boxed{\therefore B(\beta) = -\tilde{D}\beta^2}$$

$$\Delta C = C_{max} - C_{min} = (2\text{ at\% An}).$$

$$\Rightarrow C_{max} = 38\text{ at\% An} + (12\text{ at\% An})\exp[B(\beta)t]$$

$$C_{min} = 38\text{ at\% An} - (12\text{ at\% An})\exp[B(\beta)t].$$

$$\Delta C = 2(12\text{ at\% An})\exp[B(\beta)t] = 2\text{ at\% An}$$

$$\Rightarrow \boxed{\exp[B(\beta)\cdot t] = \frac{1}{12}} \Rightarrow \exp[-\tilde{D}\beta^2 t] = \frac{1}{12} \Rightarrow -\tilde{D}\beta^2 t = \ln\frac{1}{12}$$

$$\Rightarrow \boxed{t} = \frac{\ln 12}{\tilde{D}\beta^2} = \frac{\ln 12}{10^{-23}\,m^2 s^{-1}\left(\frac{2\pi}{\lambda}\right)^2} \approx \boxed{2.5\times10^4 s}$$

$$\lambda = 2\times10^{-9}\,m$$

(b):

$$\frac{dC}{dt} = \tilde{D}\frac{d^2C}{dx^2} - \frac{2K\tilde{D}}{f''}\frac{d^4C}{dx^4}$$

$$\Rightarrow \frac{d^4C}{dx^4} = \beta^4(12\text{ at\% An})\exp[B(\beta)t]\cos\beta x.$$

$$\Rightarrow (12\text{ at\% An})B(\beta)\exp[B(\beta)t]\cos\beta x = -\tilde{D}\beta^2(12\text{ at\% An})\exp[B(\beta)t]\cos\beta x - \beta^4\frac{2K\tilde{D}}{f''}(12\text{ at\% An})\exp[B(\beta)t]\cos\beta x.$$

$$\Rightarrow \boxed{B(\beta) = -\tilde{D}\beta^2 - \beta^4\frac{2K\tilde{D}}{f''}} \Rightarrow \exp\left[\left(-\tilde{D}\beta^2 - \beta^4\frac{2K\tilde{D}}{f''}\right)t\right] = \frac{1}{12}$$

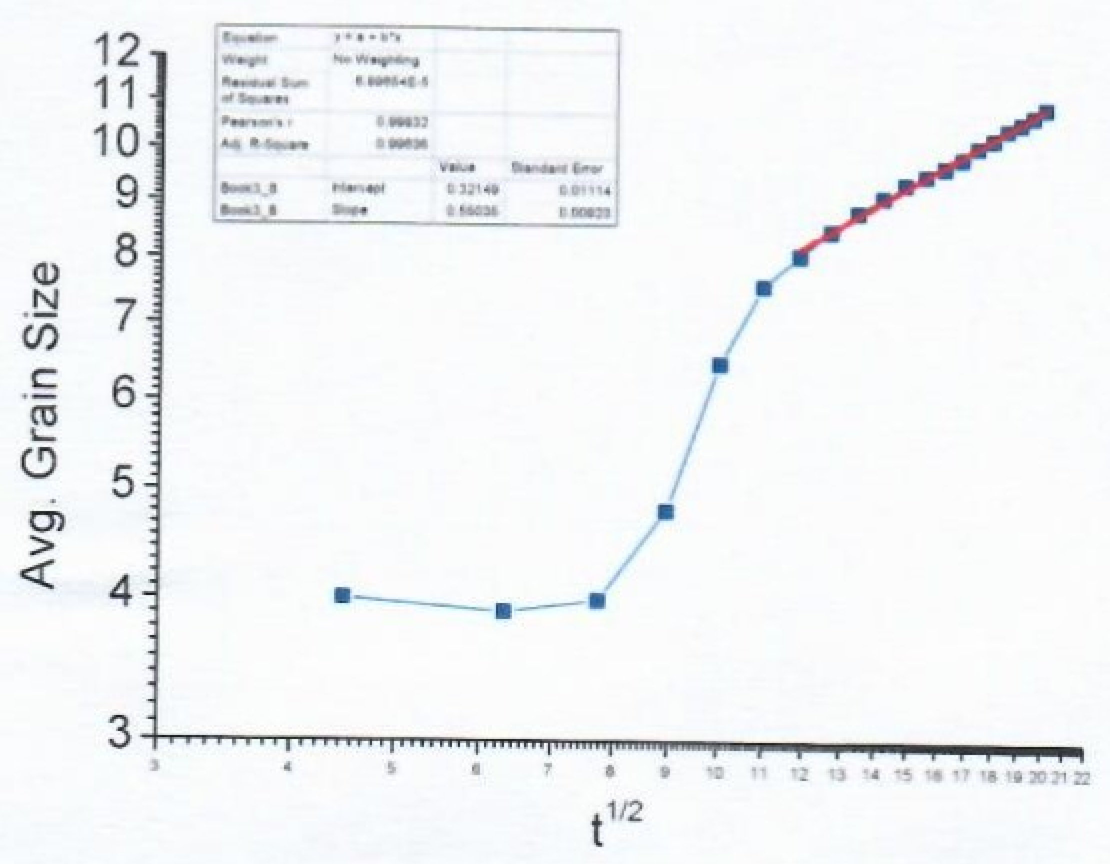
$$\Rightarrow \left[-\tilde{D}\beta^2 - \beta^4\frac{2K\tilde{D}}{f''}\right]t = \ln\frac{1}{12} \Rightarrow \boxed{t} = \frac{\ln 12}{\tilde{D}\beta^2 + \beta^4\frac{2K\tilde{D}}{f''}} = \frac{\ln 12}{10^{-23}\,m^2s^{-1}\left(\frac{2\pi}{2\times10^{-9}m}\right)^2 + \left(\frac{2\pi}{2\times10^{-9}m}\right)^4\frac{2\times(-2.6\times10^{-11})(10^{-23})}{5\times10^{9}}}$$

$$= \boxed{2.81\times10^4 s}$$

(c): Ag-rich, Au-rich 한 상이 아닌 Ag-Au bonding을 선호하는 system이며 negative gradient energy coefficient를 갖기에 fluctuation 영역이 energy적으로 안정하지 않고 nucleation이 일어나게 된다. 즉, 계면에너지를 고려할시 nucleation & Growth mechanism인 (b)가 정답일 것임.

2.

(a)



$$\bar{R} = k \cdot t^{n}$$

$$\Rightarrow \ln \bar{R} = \ln k + n \ln t.$$

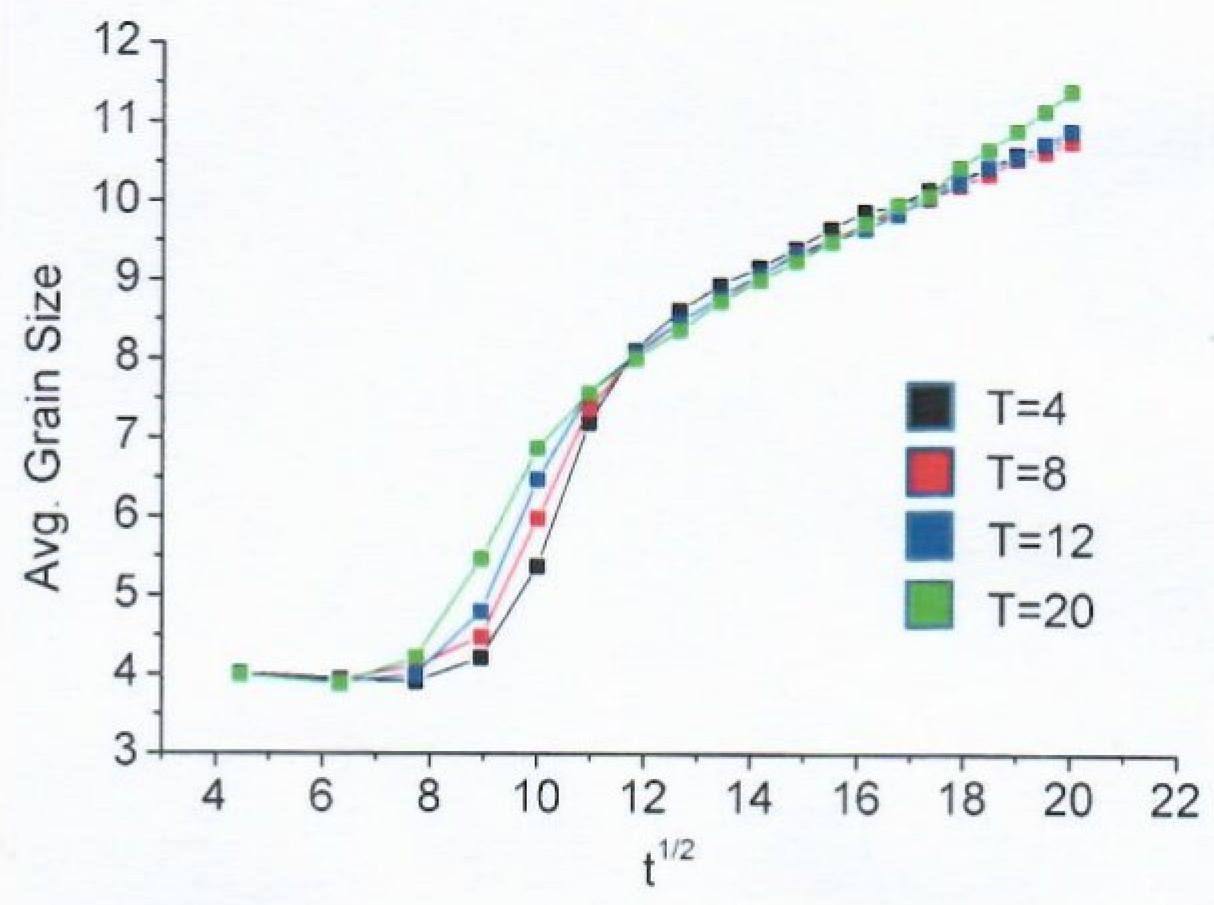
$$R^2 - R_0^2 = k t$$

$$\Rightarrow n = \frac{1}{2}$$

$$\Rightarrow \ln \bar{R} = \ln k + \frac{1}{2} \ln t.$$

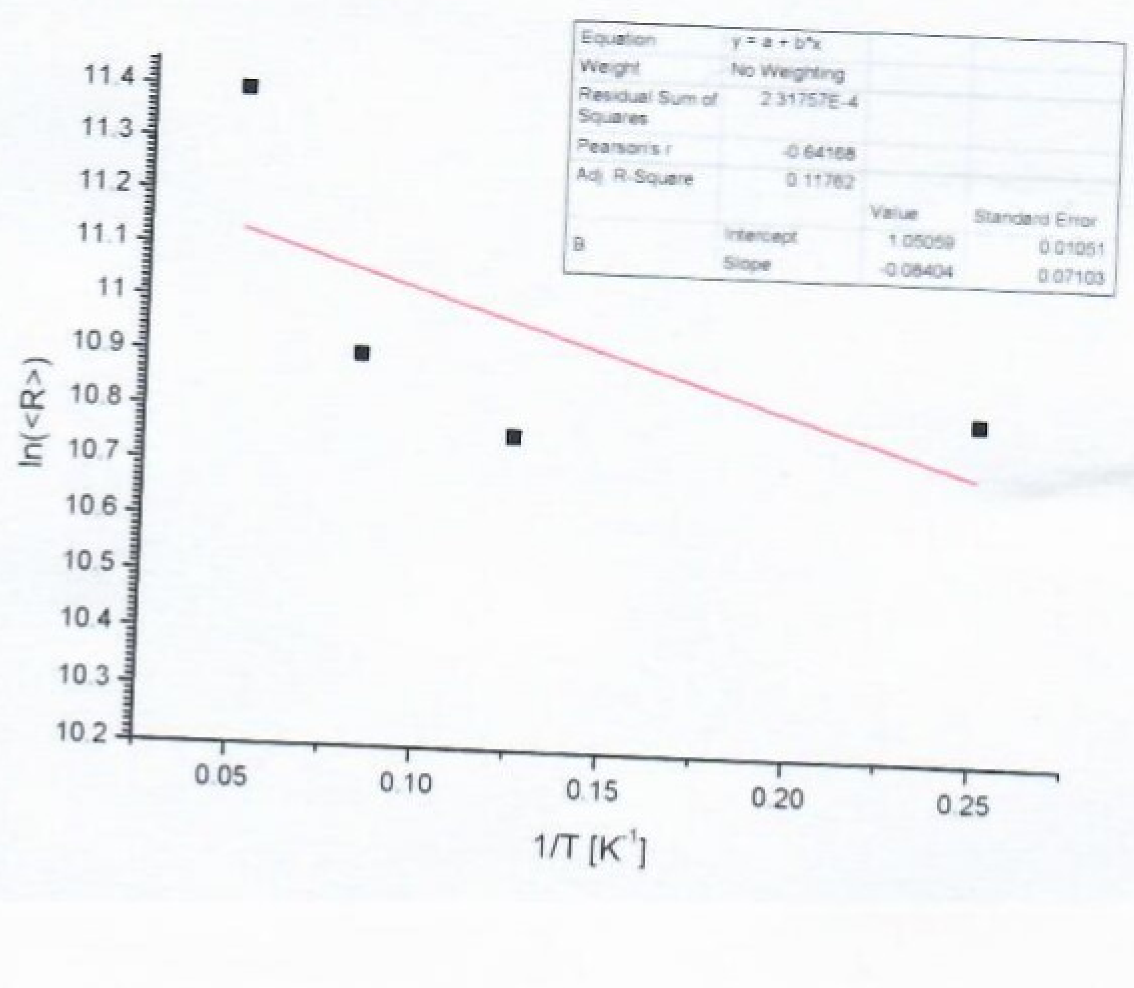
$$T = 12 \Rightarrow k = e^{0.32149} \Rightarrow 1.37918$$

(b).



$$\bar{R} = A\exp\left(-\frac{Q}{kT}\right)$$

$$\Rightarrow \ln \bar{R} = \ln A - \frac{Q}{k} \cdot \frac{1}{T}$$



$$\frac{Q}{k} = 0.084$$