REPORT

POSTECH

POHANG UNIVERSITY OF SCIENCE AND TECHNOLOGY

제목 : Homework #3

수강과목 : 상변태론

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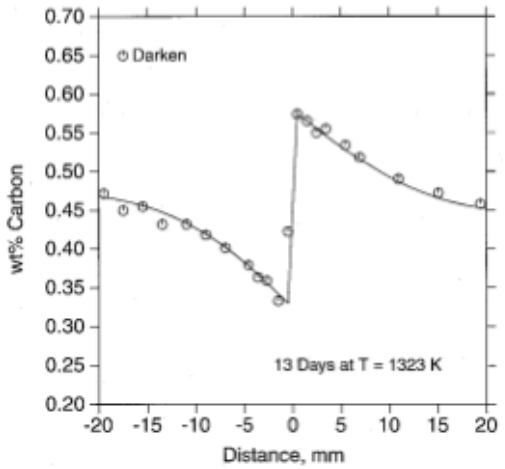
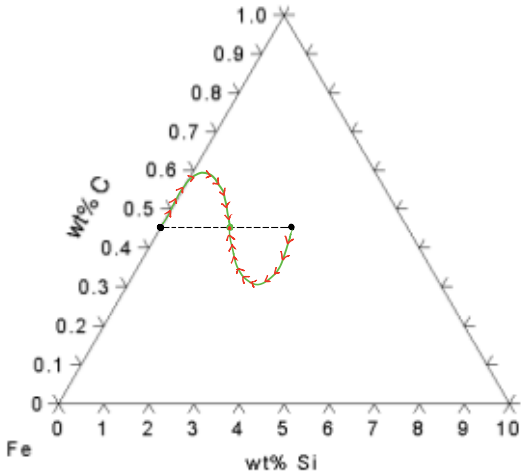
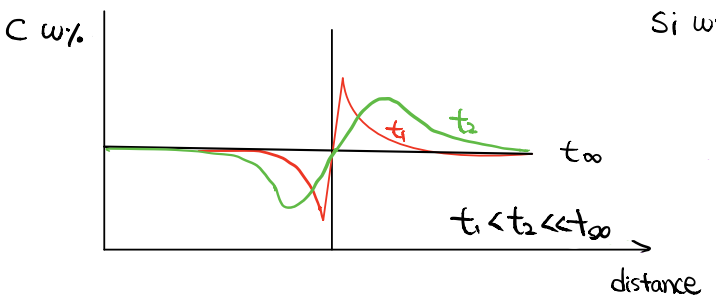
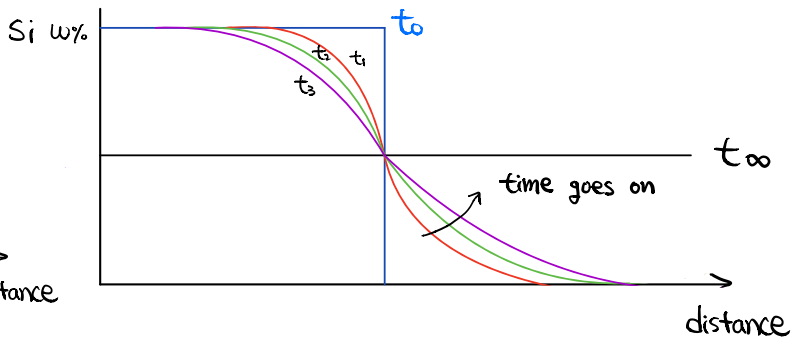
1. Plot the diffusion path for the Darken's uphill diffusion (left) on the isothermal section (right) and explain it.
How would the carbon profile and diffusion path change if the time passed more so that the Si concentration shows a non-zero gradient within 10mm across the interface? Plot the diffusion profile (left) and diffusion path (right) in comparison with those for the 13Days annealing time.





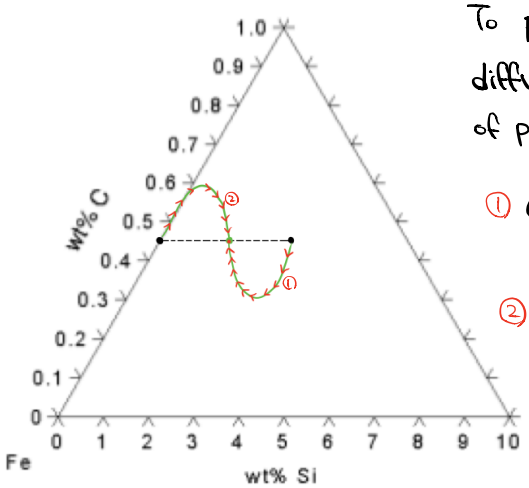
① Diffusion Profile for 13 Days annealing time





As time goes on, Carbon concentration gradient will decrease after enough time, Si also diffuse following Arrhenius equation

② Diffusion path.

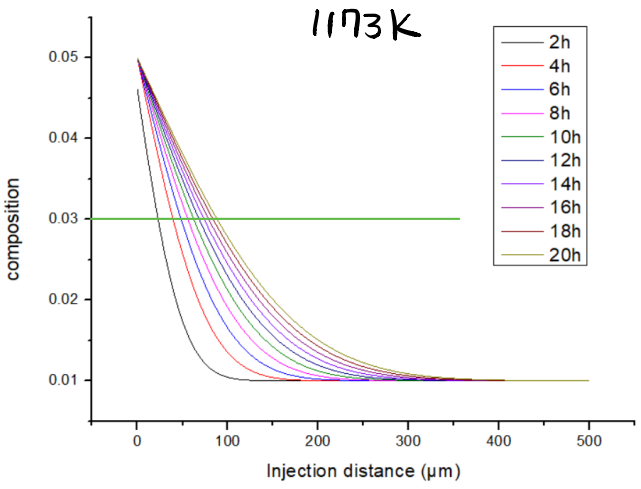


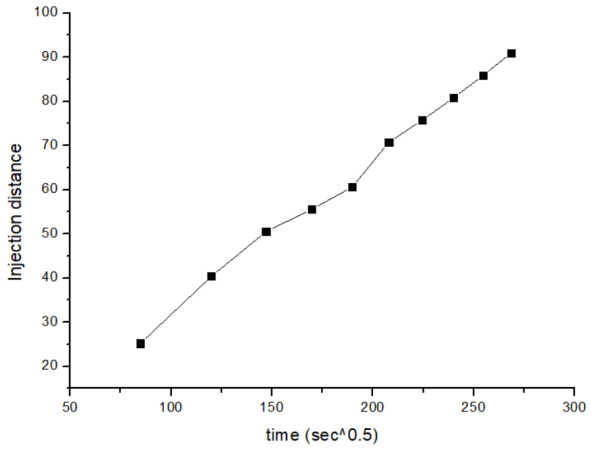
To plot the diffusion path for Darken's uphill diffusion. we need to consider the isothermal section of phase diagram of the system in question

① Carbon diffuse at the side of Si-rich, and make a non-uniform chemical potential

② Also, in Si-free layer. the high carbon concentration at the interface induce carbon diffusion

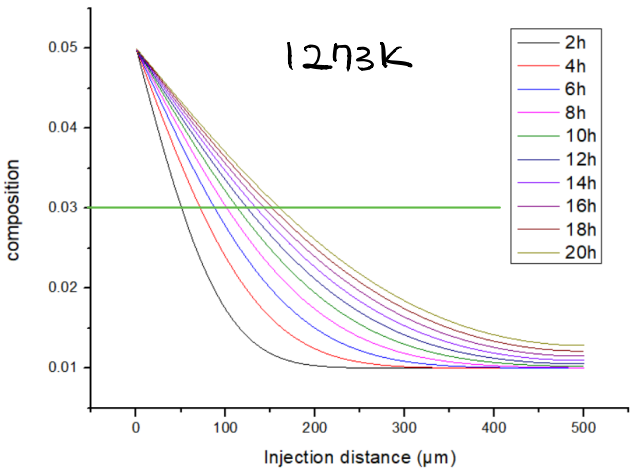
2(a). setting value (simulation length: 500 μm, time = 72000 sec (20h), number of grid = 100)

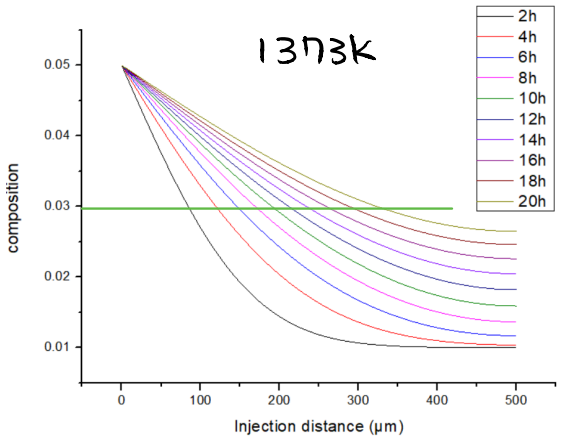


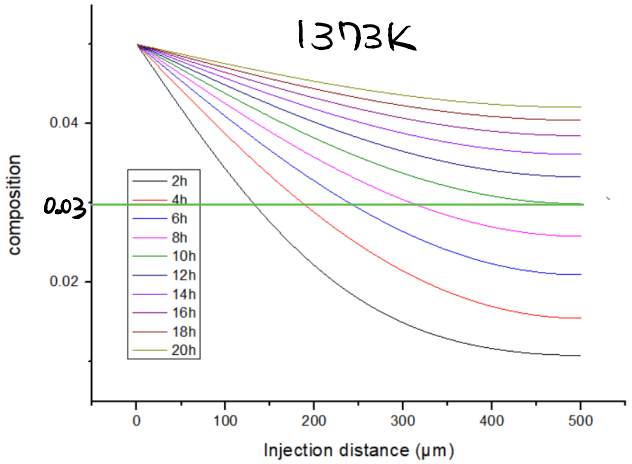


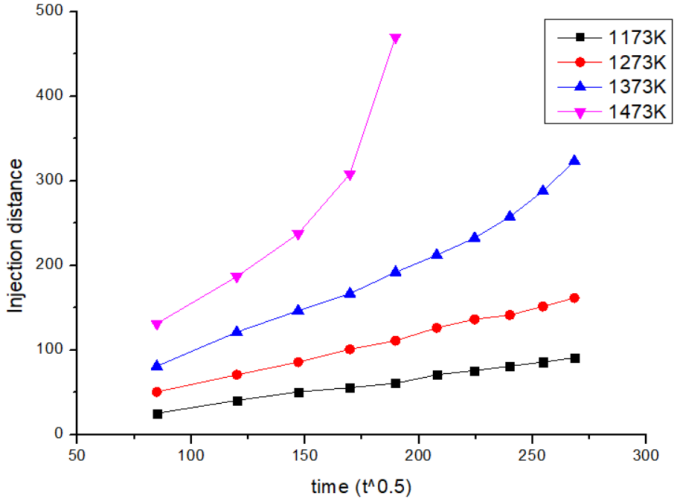
injection distance $\propto t^{0.5}$

(b)









injection distance $\propto \sqrt{\exp(\frac{-1}{T})}$

(c)

① $D = D_0 \exp(-Q_D/RT)$ (Q_D : Activation Energy)

② $x = \sqrt{Dt}$

Apply equation ① in ②, $x = D_0^{\frac{1}{2}} \exp\left(-\frac{Q}{2RT}\right)$

$$\ln x^2 = \ln(D_0 t) \exp\left(-\frac{Q}{RT}\right)$$

$$2\ln\left(\frac{x_1}{x_2}\right) = \frac{Q}{R}\left(\frac{1}{T_2} - \frac{1}{T_1}\right)$$

$$Q = 2\ln\left(\frac{x_1}{x_2}\right) R \frac{1}{\left(\frac{1}{T_2} - \frac{1}{T_1}\right)} = 2\ln\left(\frac{25.25}{50.5}\right) \times 8.3145 \times \frac{1}{\frac{1}{1273} - \frac{1}{1173}}$$

$$= 172114 \text{ J}$$