상변태 HW 4 2020223808 권오혁

1. $I = f_0 N_0 \exp\left(-\frac{\Delta G^*}{kT}\right) = f_0 N_0 \exp\left(-\frac{A}{(\Delta T)^2}\right)$

$r^* = \frac{2\gamma}{\Delta G_v}$, $\Delta G^* = \frac{16}{3}\pi \frac{\gamma^3}{(\Delta G_v)^2}$

(From data)

① $\ln I = \ln(f_0 N_0) - \frac{\Delta G^*}{k}\cdot\frac{1}{T}$ ∴ $\Delta G^* = (1.38\times10^{-23}\,J/K)\cdot(23.8\times10^{3}\,K)$

$= 32.844\times10^{-20}\,J$

② $\Delta G^* = \frac{16\pi}{3}\frac{\gamma^3}{(-10^8\,J/m^3)^2} = 32.844\times10^{-20}\,J$

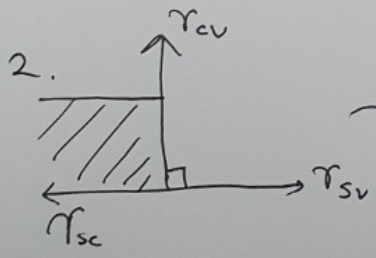
$\therefore \gamma^3 = 32.844\times10^{-20}\,J \times \frac{3}{16\pi} \times 10^{16}\,J^2/m^6 = 1.96\times10^{-4}\,J^3/m^6$

$\gamma = 0.0581\,J/m^2$. ∴ a) $\gamma = 0.0581\,J/m^2$

b) $r^* = \frac{2\gamma}{\Delta G_v} = 0.1162\times10^{-8}\,m = 1.16nm$

$\frac{4}{3}\pi r^{*3} = \frac{4}{3}\pi r^3 \times n$ → c) $n = \left|\frac{r^*}{r}\right|^3 = \left(\frac{11.62}{1.5}\right)^3 = 464.88 \simeq 465$개.

2.



→ $\gamma_{sc} = \gamma_{sv}$.

① $\left(\frac{\partial \Delta G}{\partial h}\right)_{\substack{h=h^*\\ l=l^*}} = 4l\cdot\gamma_{cv} - l^2\Delta G_v = 0$ → $l^* = \frac{4\gamma_{cv}}{\Delta G_v}$. //

② $\left(\frac{\partial \Delta G}{\partial l}\right)_{\substack{h=h^*\\ l=l^*}} = (4h+2l)\gamma_{cv} - 2hl\Delta G_v = 0$

$h^* = \frac{-l^*\cdot\gamma_{cv}}{2\gamma_{cv} - l^*\cdot\Delta G_v} = \frac{2\gamma_{cv}}{\Delta G_v}$ //

$\Delta G = -V_s\cdot\Delta G_v + \Sigma A_i\gamma_i$

$= -hl^2\Delta G_v + 4hl\gamma_{cv} + l^2\gamma_{cv} + l^2\gamma_{sc} - l^2\gamma_{vs}$

$= (4hl + l^2)\gamma_{cv} - hl^2\Delta G_v = \frac{16\gamma_{cv}^3}{\Delta G_v^2}$ 대입.

~~For non-spherical nucleations, $\Delta G^* = \frac{1}{2}V^*\Delta G_v = \frac{1}{2}h^*l^{*2}\Delta G_v$~~

~~$\rightarrow (4h^*l^* + l^{*2})\gamma_{cv} - h^*l^{*2}\Delta G_v = \frac{1}{2}h^*l^{*2}\Delta G_v$~~

~~$(4h^* + l^*)\gamma_{cv} = \frac{3}{2}h^*l^*\Delta G_v$.~~

$\rightarrow \Delta G^* = \frac{4h^* + l^*}{3}\cdot\gamma_{cv}$.

$= \frac{4\gamma_{cv}^2}{\Delta G_v}$