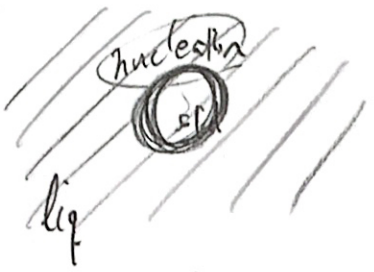
2018254088 서정빈

1.



homogeneous nucleation a spherical nucleus

$$\Delta G = -\frac{4}{3}\pi r^3 \Delta G_v + 4\pi r^2 \gamma$$

for critical size of nucleation (r^*). $\left.\frac{\partial \Delta G}{\partial r}\right|_{r=r^*} = 0$

$$\left.\frac{\partial \Delta G}{\partial r}\right|_{r=r^*} = -4\pi r^{*2} \Delta G_v + 8\pi r^* \gamma = 0$$

$$r^* = \frac{2\gamma}{\Delta G_v}$$

Put $r^* = \frac{2\gamma}{\Delta G_v}$ into $\Delta G^* = -\frac{4}{3}\pi r^3 \Delta G_v + 4\pi r^2 \gamma$

$$= -\frac{4}{3}\pi \frac{8\gamma^3}{\Delta G^3_v} + 4\pi\gamma \times \frac{4\gamma^2}{\Delta G^2_v}$$

$$= +\frac{16}{3}\frac{\pi\gamma^3}{\Delta G_v^2}$$

Nucleation Rate

$$\Rightarrow I = f_0 N_0 \exp\left(-\frac{\Delta G^*}{kT}\right) = I_0 \exp\left(-\frac{\Delta G^*}{kT}\right)$$

$$\ln I = \ln I_0 - \frac{\Delta G^*}{kT}$$

Slope of $\ln I$ versus $\frac{1}{T}$ at 113℃ $\Rightarrow -\frac{\Delta G^*}{k} = -23.6\times10^3\ K$

$$\Delta G^* = 23.6\times10^3\ K \times 1.38\times10^{-23}\ J/K = 32.8\times10^{-20}\ J$$

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

$$32.8\times10^{-20}\ J = \frac{16\pi}{3} \times \frac{\gamma^3}{(-10^9\ J/m^{-3})^2}$$

$$\gamma \approx 0.058\ J/m^2$$

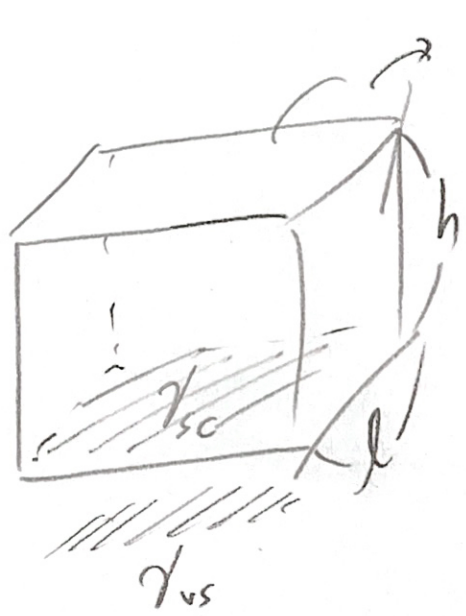
(b) $r^* = \frac{2\gamma}{\Delta G_v} = \frac{2 \times 0.358}{-10^8\ J/m^3} \simeq 1.16 \times 10^{-9}\ m$

(c) number of molecules in nucleus : n.

$$n = \left(\frac{\text{radius of nucleus}}{\text{radius of atom}}\right)^3 = \left(\frac{r^*}{r}\right)^3 = \left(\frac{1.16 \times 10^{-9}\ m}{1.5 \times 10^{-10}\ m}\right)^3 \approx \boxed{462}$$

(Spherical volume)
$\Rightarrow \boxed{r^3}$

2

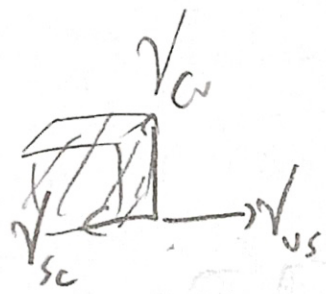


12

$$\Delta G = -\Delta G_v l^2 h + \gamma A$$

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

아래면.



$\Rightarrow \gamma_{sc} = \gamma_{vs}$

$$\therefore \Delta G = -\Delta G_v l^2 h + \gamma_{cv}(4hl + l^2)$$

Critical Point

$$\left.\frac{\partial \Delta G}{\partial h}\right|_{h=h^*} = 0 \Rightarrow -\Delta G_v l^2 + \gamma_{cv} \times 4l = 0 \Rightarrow l^* = \boxed{\frac{4\gamma_{cv}}{\Delta G_v}}$$

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

$$(4\gamma_{cv} - 2l^* \Delta G_v) h^* = -2\gamma_{cv} l^*$$

$$\therefore h^* = \frac{\gamma_{cv} l^*}{l^* \Delta G_v - 2\gamma_{cv}} = \frac{\frac{4\gamma_{cv}^2}{\Delta G_v}}{2\gamma_{cv}} = \boxed{\frac{2\gamma_{cv}}{\Delta G_v}}$$

$$\therefore l^* = \frac{4\gamma_{cv}}{\Delta G_v} \quad \& \quad h^* = \frac{2\gamma_{cv}}{\Delta G_v}$$