03.03.2022

3322

Lecture 21

* $G^{LW}_{Film} = C - \frac{A_{11}}{12\pi h^2}$ *

Interfacial VDW Interaction.

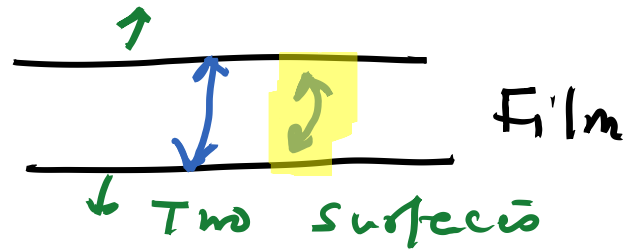
If $h \to \infty$ (Large), Then G^{LW}_{Film} = Constant

($h > 100$ nm)

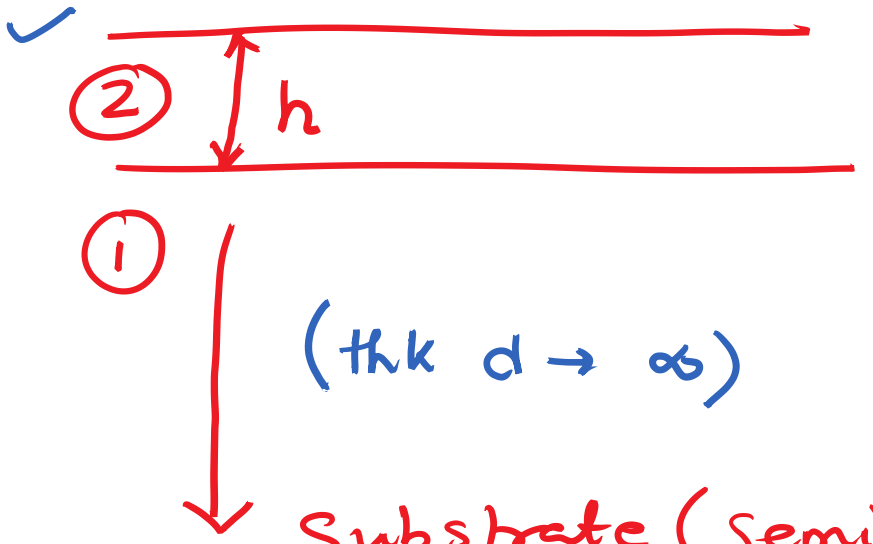
→ If h is low, (Small) then $G^{LW}_{Film} = f(h)$

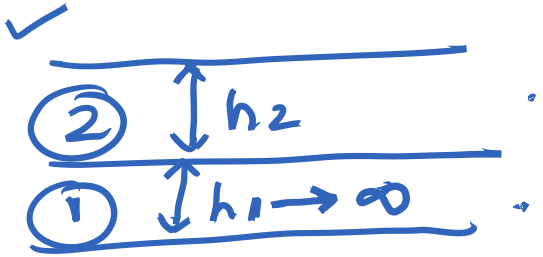
What is a Thin Film? →

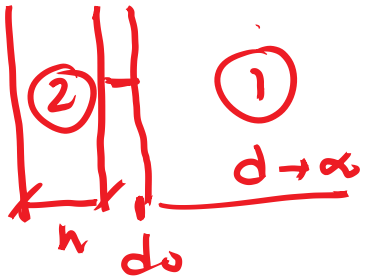
A film in our context is THIN as long as G of the Film is a function of h. → If there is active (non zero) VDW Interaction between its two interfaces.



Supported Thin Film







$$G^{LW}_{System} = G^{LW}_{Film} + G^{LW}_{Substrate} + G^{LW}_{1-2\ Interface}$$

$$= \left(C_1 - \frac{A_{22}}{12\pi h^2}\right) + \left(C_2 - \frac{A_{11}}{12\pi d^2}\right)$$

($\frac{A_{11}}{12\pi d^2} \to 0$)

$$- \frac{A_{12}}{12\pi}\left[\frac{1}{d_0^2} + \frac{1}{(d+h+d_0)^2}\right]$$

($d \to \infty$)

$$- \frac{1}{(d+d_0)^2} - \frac{1}{(h+d_0)^2}\Bigg]$$

($\frac{1}{(d+d_0)^2} \to 0$, $d \to \infty$)

($h + d_0 \approx h$)

$$G^{LW}_{System} = (C_1 + C_2) - \frac{A_{22}}{12\pi h^2} - \frac{A_{12}}{12\pi d_o^2} + \frac{A_{12}}{12\pi h^2}$$

$$= C - \frac{(A_{22} - A_{12})}{12\pi h^2}$$

C = Combined Constant

$$G^{LW}_{System} = C - \frac{A_E}{12\pi h^2}$$

A_E = Effective Hamaker Const $= A_{22} - A_{12}$

For a supported thin Film $G^{LW} = f(h)$. if the film thk is Less.

If h is thick G^{LW} = constant
= $(\gamma_1, \gamma_2, \gamma_{12}$ etc).

$$G^{LW}_{Film} = C - \frac{A_E}{12\pi h^2} = G^{LW}_{System \rightarrow \text{Supported Thin Film}}$$

$$\Pi = -\frac{\partial(\Delta G^{LW})}{\partial h} = \frac{A_E}{6\pi h^3}$$

Disjoining Pressure ↑ How the Excess free Energy of the System varies with h.

$$\Delta G^{LW}_{Film\ System} = G^{LW}_{Film}\Big|_{h\ (Finite)} - G^{LW}_{Film\ System}\Big|_{h \to \infty\ Thick} = -\frac{A_E}{12\pi h^2}$$

Excess free Energy due to its thinness.