

3.044 MATERIALS PROCESSING

LECTURE 21

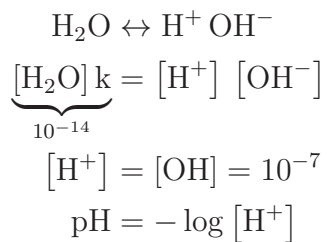
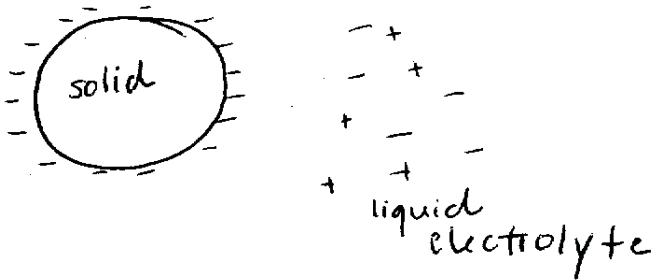
Powder Consolidation: often easier than making the shape

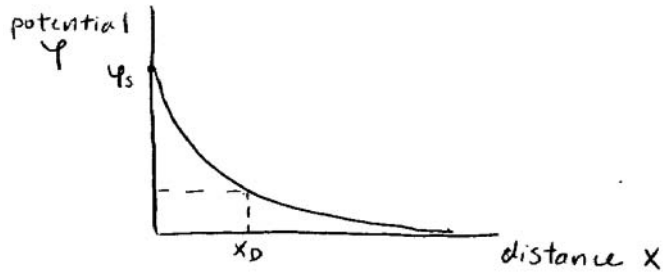
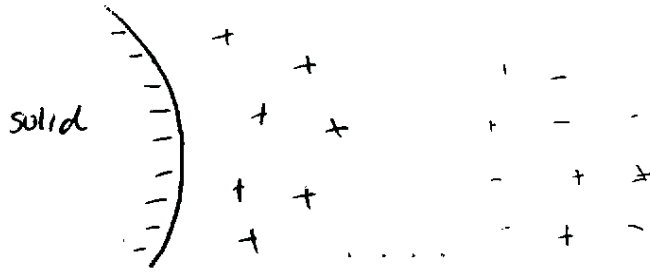


Slurry/Colloid Processing:

- suspend particles in a fluid
- use fluid flow to make shapes
- remove fluid
- sinter

Aqueous Solutions:





$$\varphi = \varphi_s \exp\left(-\frac{x}{x_D}\right)$$

$$x_D = \left[\frac{\varepsilon_r \varepsilon_0 R T}{\sum_i n_i z_i^2 F^2} \right]$$

ε_r dielectric constant

ε_0 permativity of free space = $9 \times 10^{-12} \frac{C}{Jm}$

R gas constant (per mole)

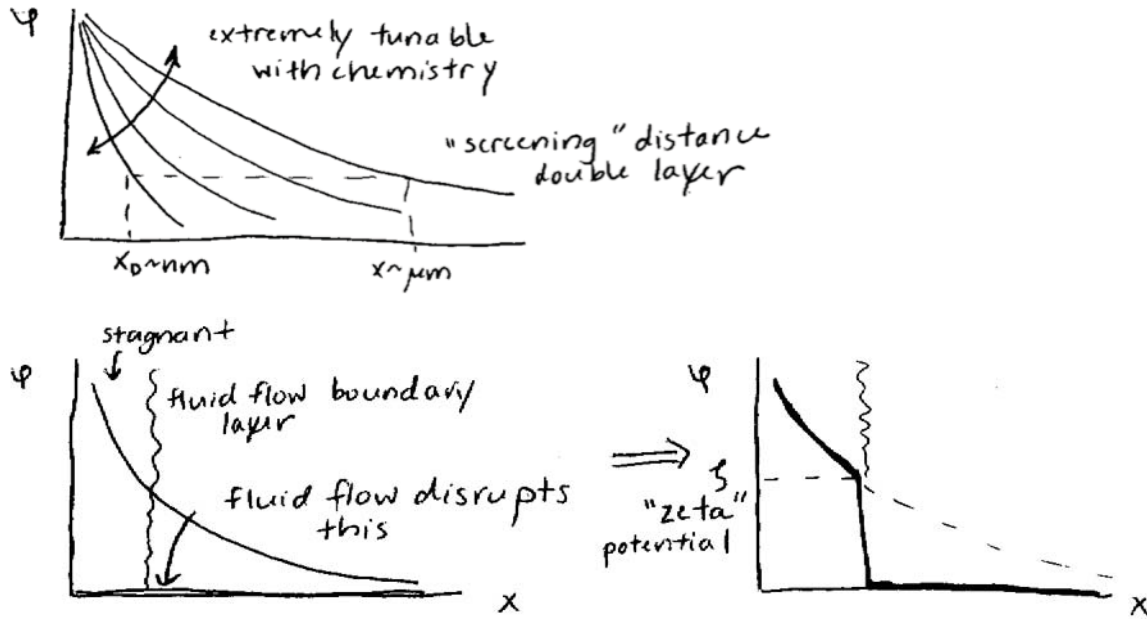
T temperature

n_i concentration of ions present

z_i charge fo ions present

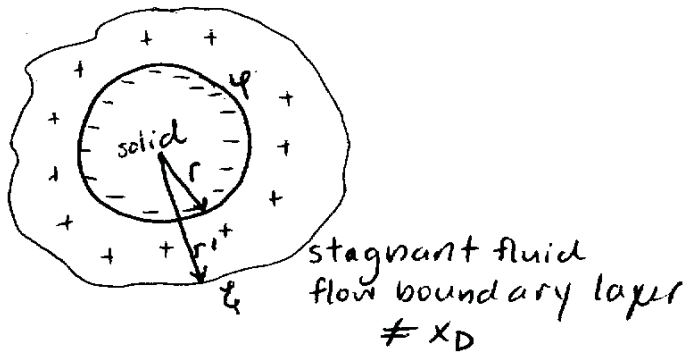
F Faraday's constant = $9.7 \times 10^4 \frac{C}{mol}$

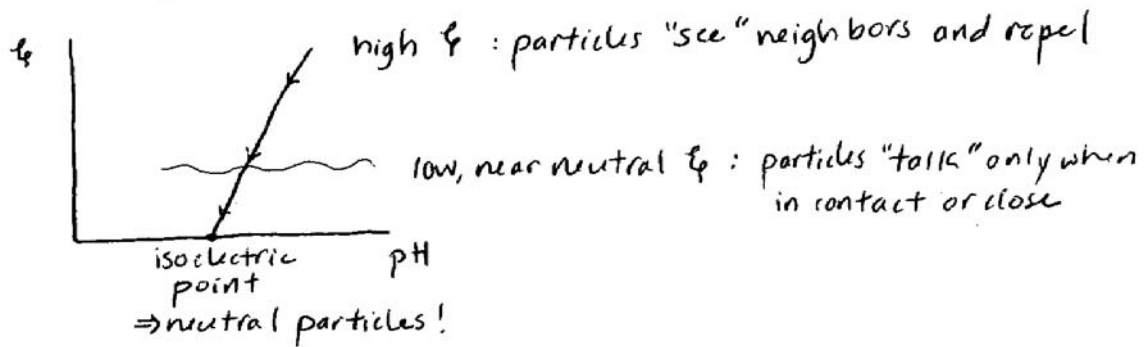
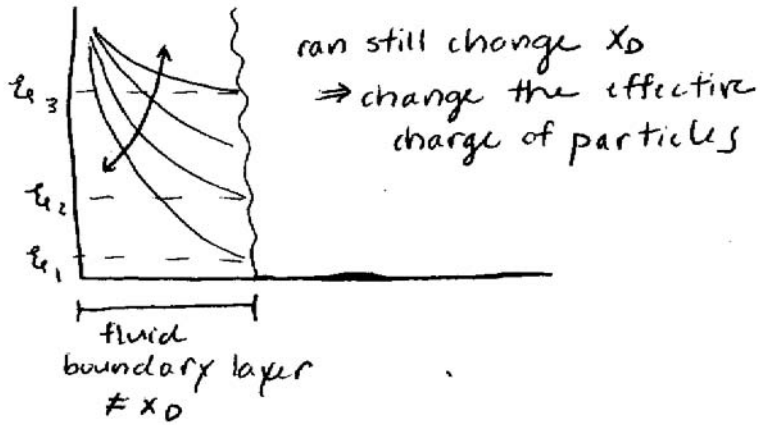
| For Water | For H ₂ O + 0.01M HNO ₃ |
|----------------------|--|
| $\varepsilon_r = 80$ | $\varepsilon_r = 80$ |
| T = 300K | T = 300K |
| $n_{H^+} = 10^{-7}$ | $n_{H^+} = 10^{-2}$ |
| $z_{H^+} = 1$ | $z_{H^+} = 1$ |
| $n_{OH^-} = 10^{-7}$ | $n_{OH^-} = 10^{-2}$ |
| $n_{OH^-} = -1$ | $n_{OH^-} = -1$ |



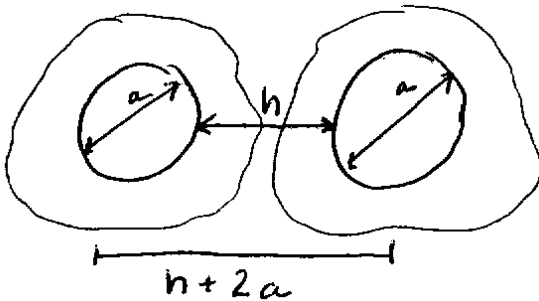
Fluid Flow:

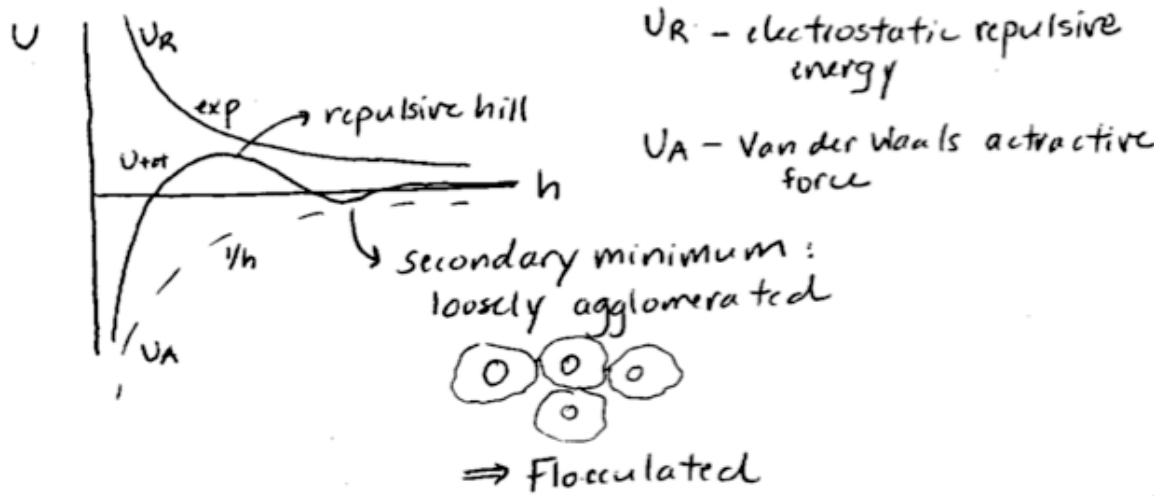
- induced during processing
- suspended particle always moves by **Brownian motion**





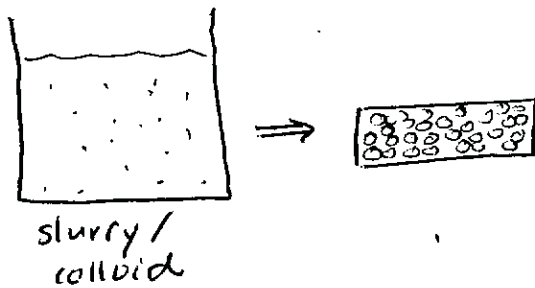
Particle Interactions in Suspension



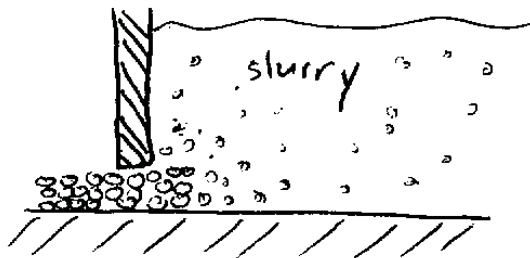


Van der Waals attract: $U_A = \frac{A_a}{12h}$, where A_a is the Hamaker Constant

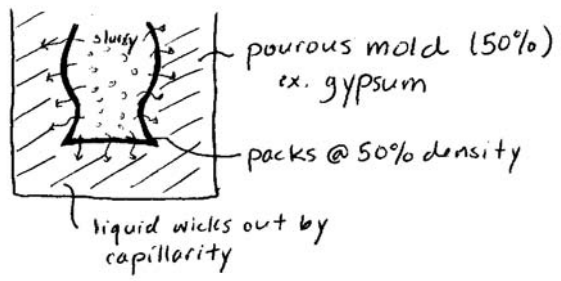
Powder Packing from Slurry:



- A) Driven by gravity (acceleration)
 - slurry settling
 - centrifugal casting
- B) Driven by fluid removal
 - tape casting (electronics)



· slip casting



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