CVD Virtual Lab

Key Points: First day on the job! You are given a task to develop a recipe for film deposition, you know nothing (but have access to reference books, colleagues, the vast scientific literature), and have the determine what is important (and ideally why) without breaking the bank!

Shannon Boettcher – Semiconductor Device Processing
Adapted from Prof. Milo Koretsky, OSU

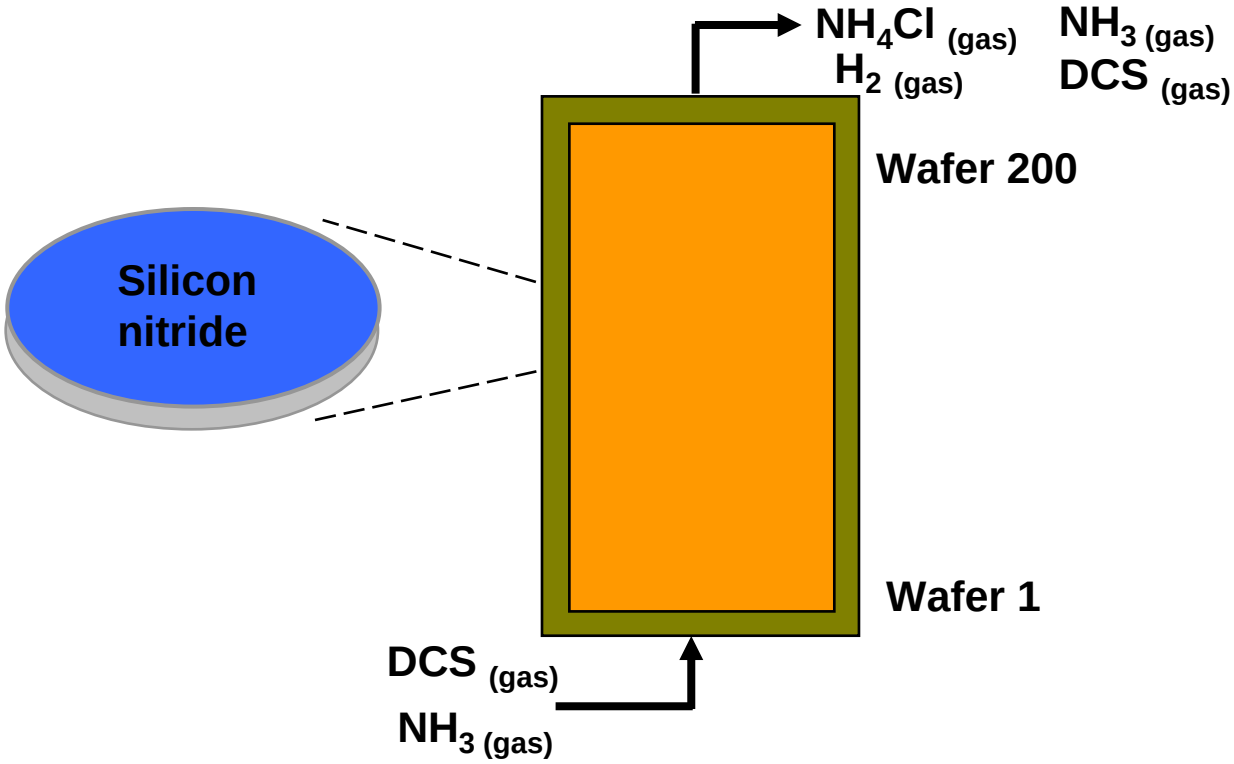
Silicon Nitride LPCVD

Overall Reaction:

$SiCl_2H_2$ (g) + NH_3 (g) → Si_3N_4 (s)

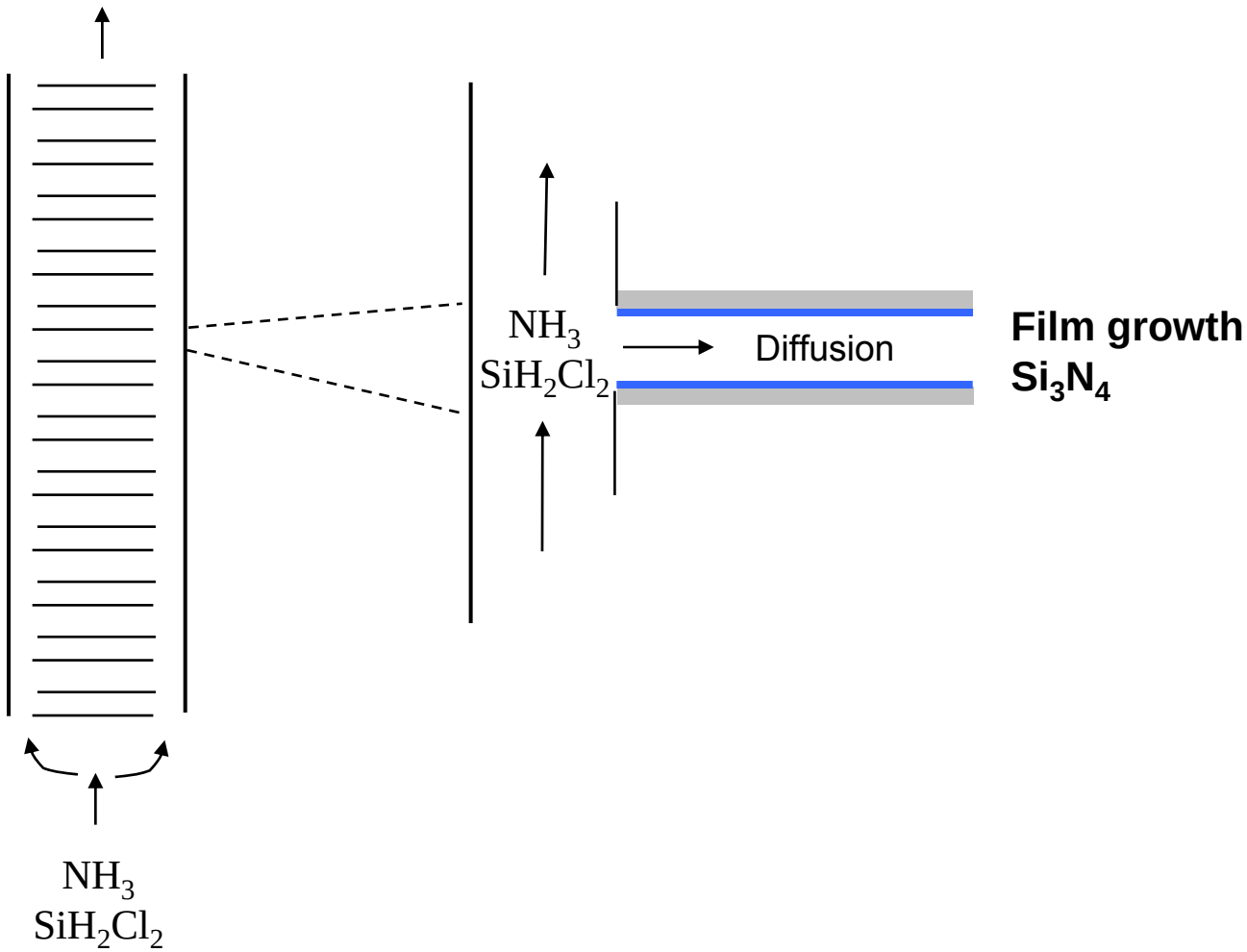
Dichlorosilane (DCS) | Ammonia | Silicon nitride

You should think about the balanced equation!

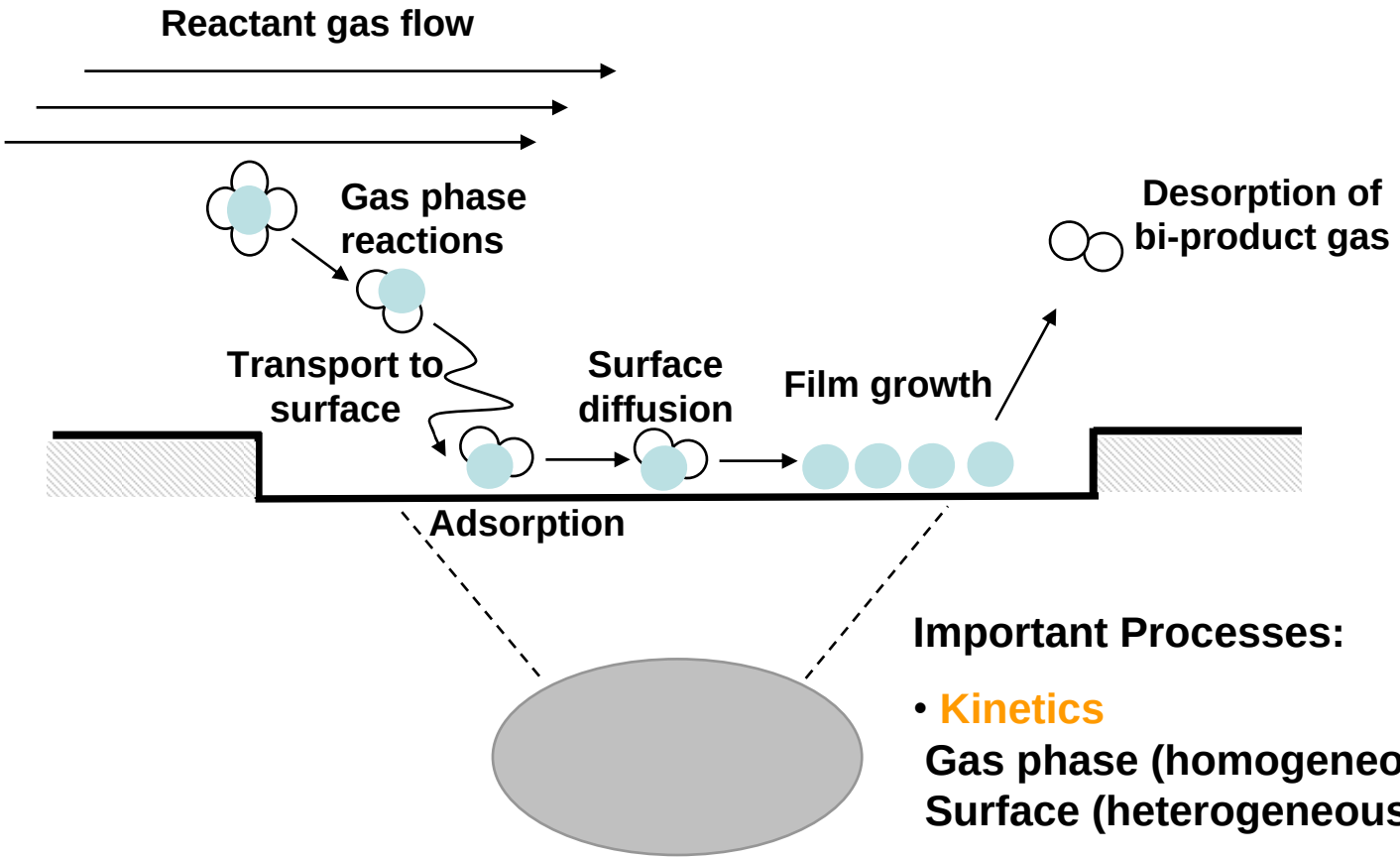


Chemical Deposition is a process CENTRAL to fabrication of electronic devices.

Basic Processes in CVD



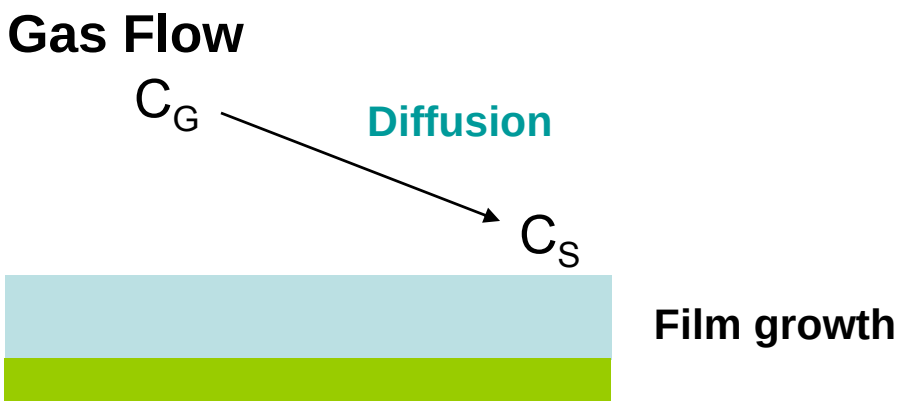
Basic Processes in CVD



Important Processes:

- **Kinetics**
  Gas phase (homogeneous)
  Surface (heterogeneous) reactions
- **Mass transport phenomena**

Mass Transport & Reaction in CVD

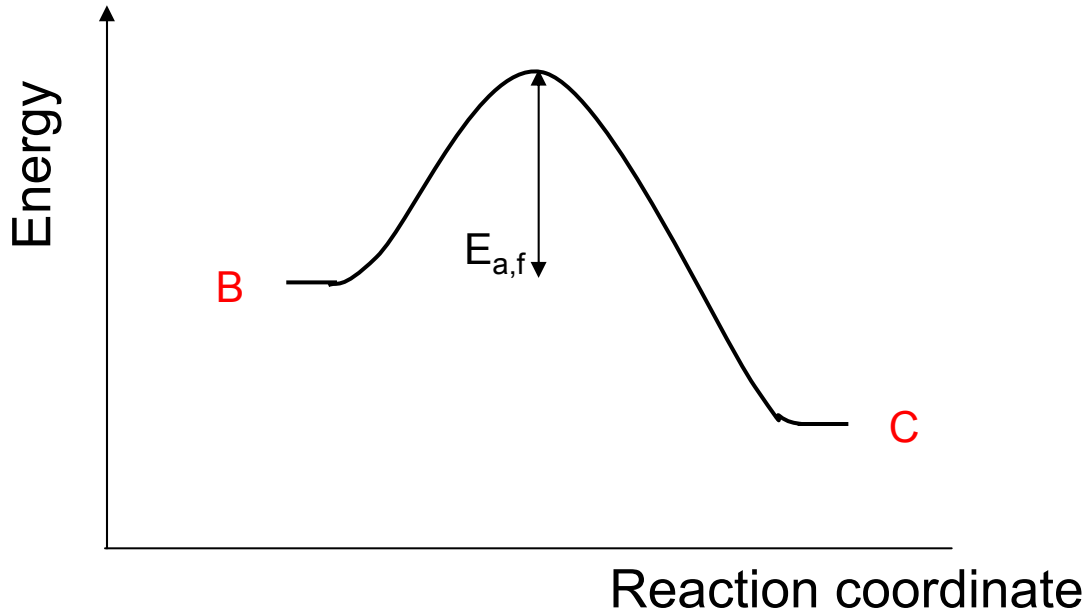


Flux of reactant species	**Mass Transport**	**Surface Reaction**
	J	R

Reaction Kinetics

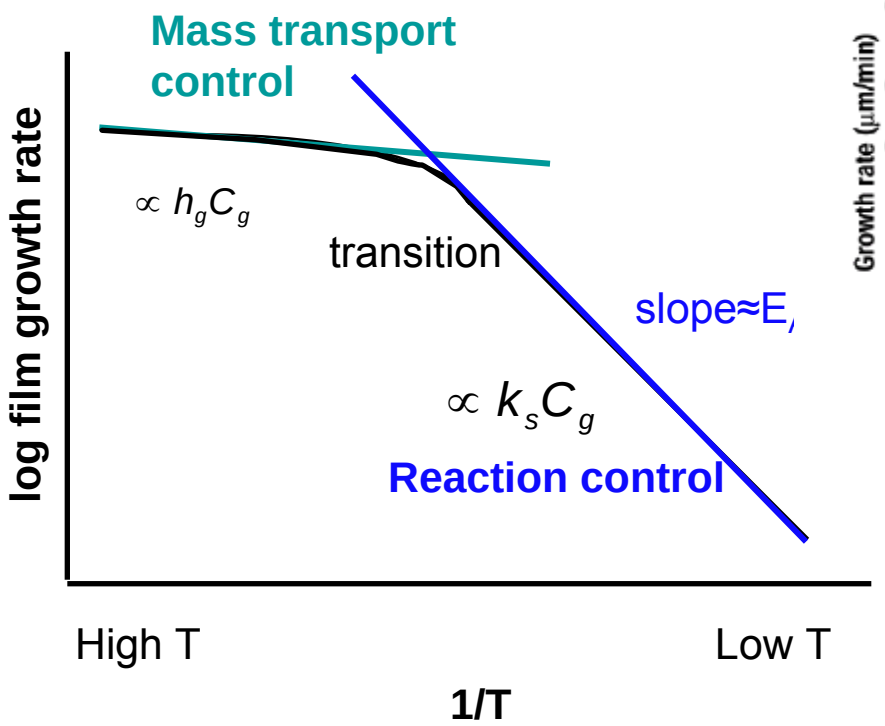
First order reaction (thermal): B $\longrightarrow$ C

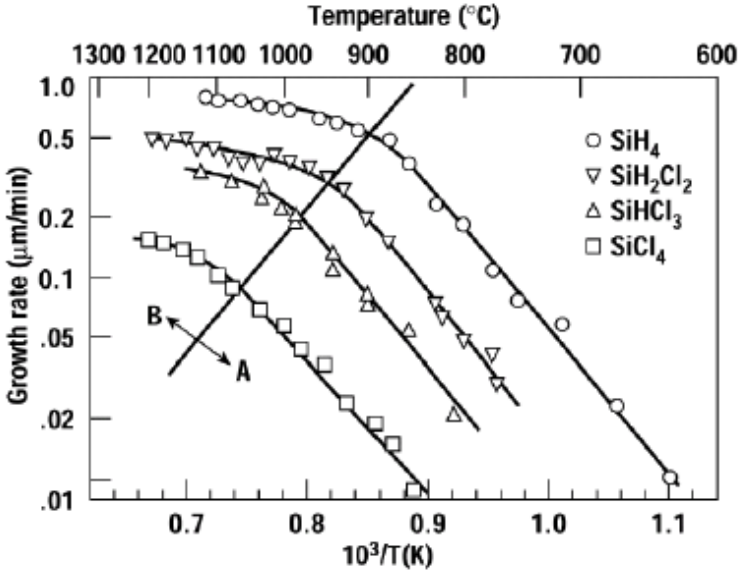
$$\Re = kC_B \qquad \text{where} \qquad k = k_0 \exp\left(-\frac{E_{a,f}}{RT}\right)$$



Mass Transport vs. Surface Reaction

Arrhenius Plot

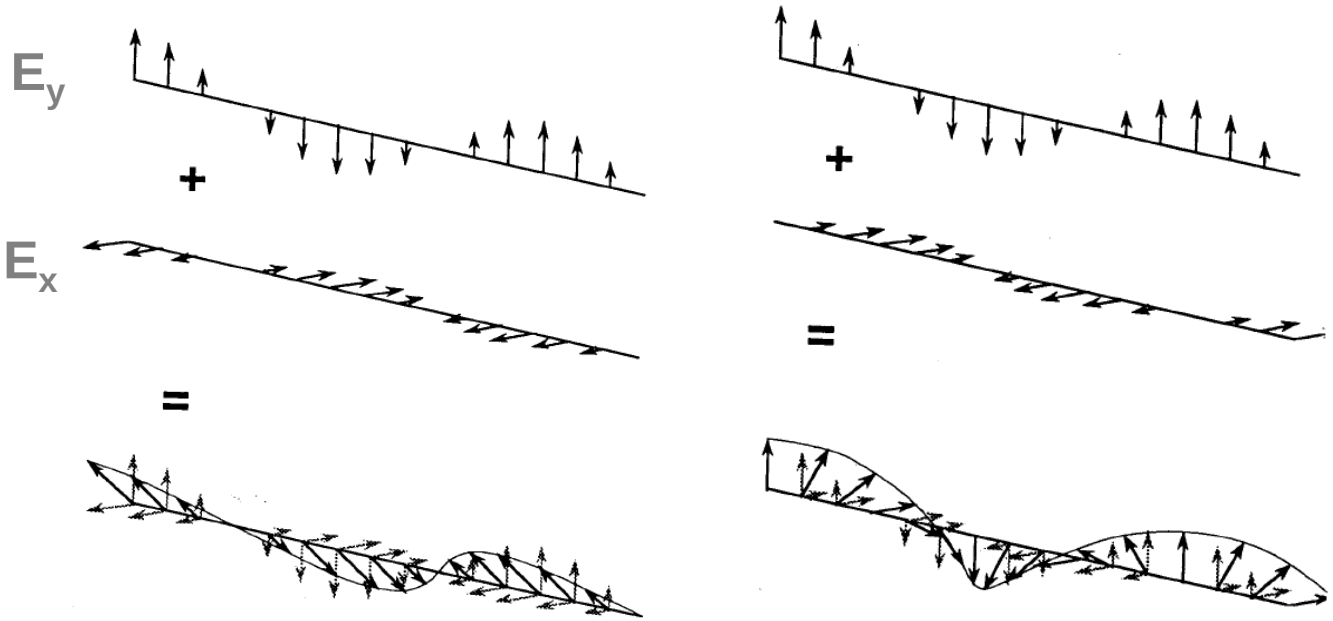




Eversteyn

Thickness Measurement Ellipsometer
Polarized Light

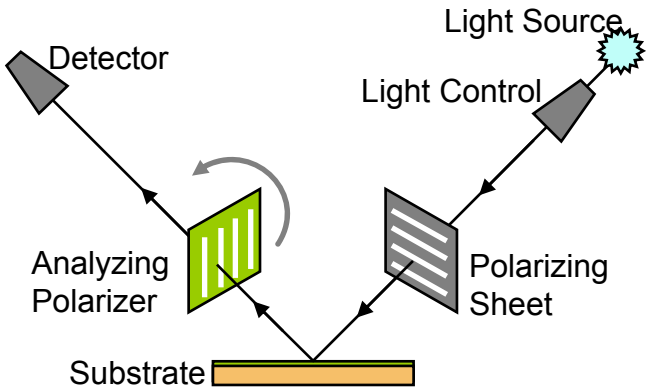
Light – electromagnetic radiation; transverse electric and magnetic fields

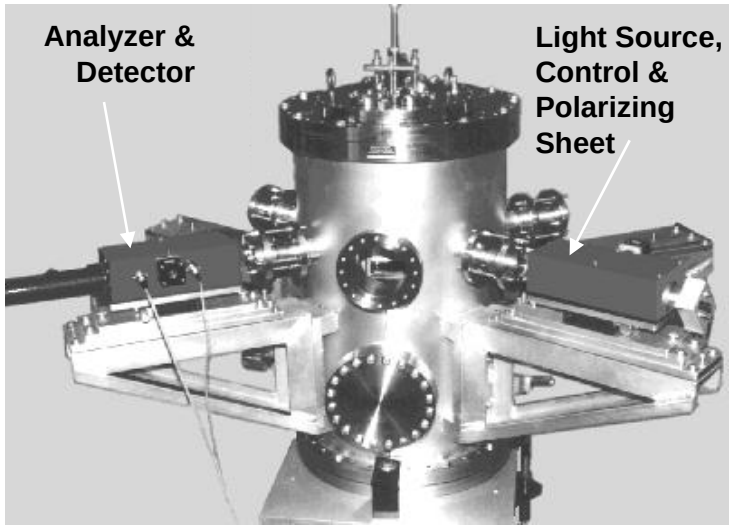


Linearly Polarized **Circularly Polarized**

Thickness Measurement Ellipsometer

- The ellipsometer is used to measure the thickness and refractive index of transparent films.
- It is made of a light source and polarizer on one side and a analyzer and detector on the other side.





- Light from the source is polarized and reflected off the film.
- The analyzer is rotated till no light passes through it.
- The angle of rotation depends on the thickness and optical constants of the film.