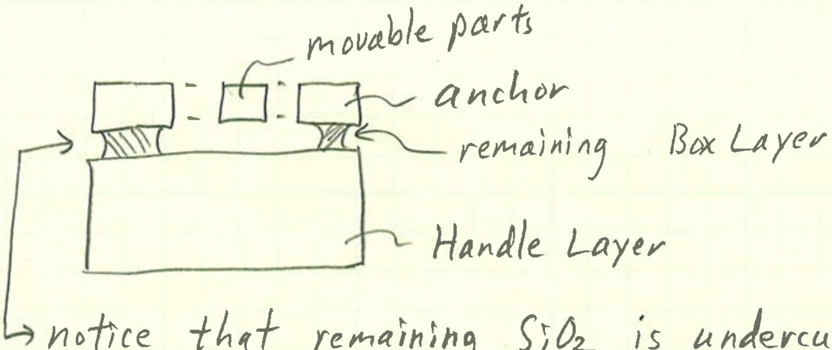
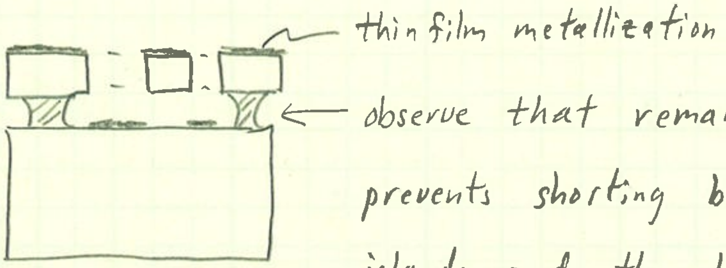


→ notice that remaining SiO_2 is undercut from the sides of the Device Layer anchors

⑦ <u>Thin Film Metallization</u> (such as sputtering)

→ thinner than the Box Layer thickness



← observe that remaining Box Layer prevents shorting between Device Layer islands and the handle layer

4) SIMOX SOI wafers

Oxygen ions accelerated and impact Si wafer (Ion Implantation) →

→ move into the Si wafer to a specific depth → form an SiO_2 layer

→ Device layer is thin ~200nm for example, Box ~ 375nm

→ these SOI wafers used in special IC fabrication processes

→ <u>SIMOX</u> → Separation-by-IMplantation-of-OXygen

I. Chapter 11 - Surface Micromaching

→ using the Si substrate as a holder, where freestanding micromechanical structures are fabricated on the substrate surface through the addition (deposition) and subtraction (etching) of thin films, using sacrificial layers

a. Deposited thin and thick fims

① Thick films → ≥ few μm thick

② Thin films → ≤ few μm thick

b. Thick film deposition

① screen printing

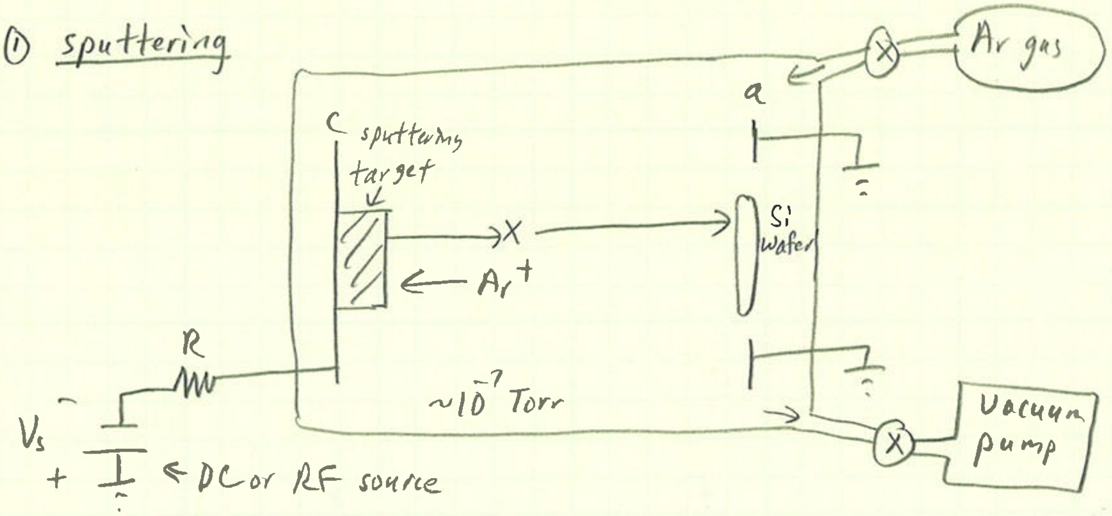
② plating → electro and electroless

③ spin coating

④ lamination → layers bonded through pressure and heat

c. Thin film deposition (more typical of Surface Micromachining)

① sputtering

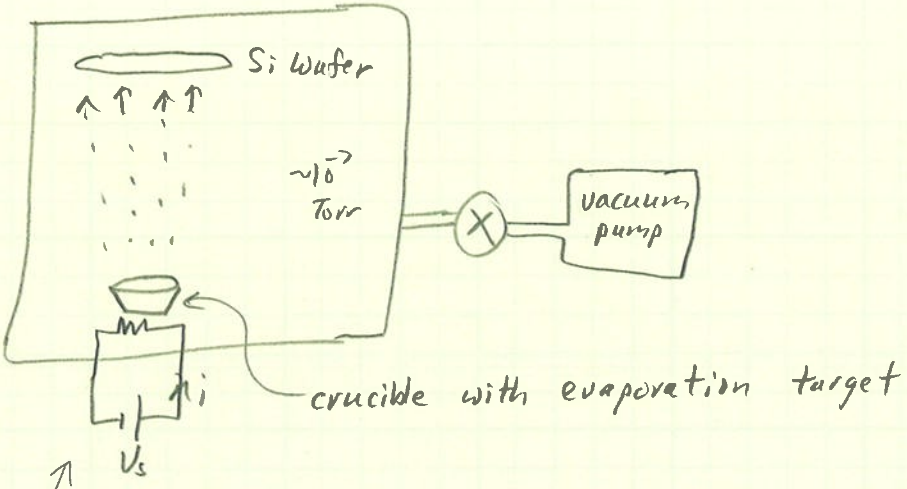


Ar^+ ions bombard sputtering target with sufficient KE to knock target material atoms off. They diffuse across the vacuum chamber and strike the wafer at ~90°, building up a thin film

→ metals and dielectric materials can be sputtered

② <u>Evaporation</u>

The material to be deposited is evaporated in a vacuum chamber. The vapor diffuses across the vacuum chamber and deposits on the Si wafer at ~90°

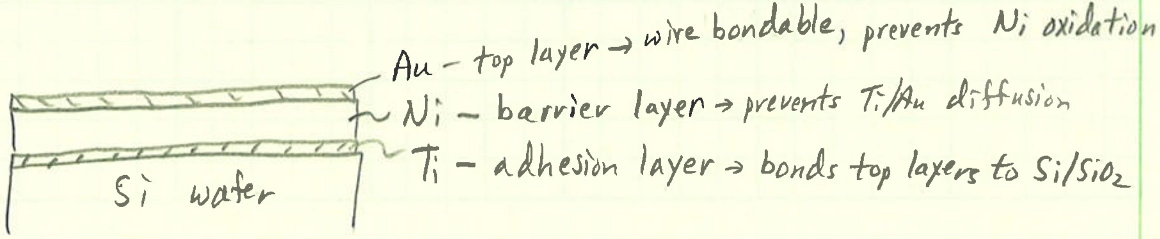


"<u>thermal evaporation</u>" → uses resistive heating to vaporize the deposition material

→ <u>Electron Beam or "E-Beam" Evaporation</u>

- uses an electron beam to evaporate the target material in the crucible
- 2 electron beam system → evaporate 2 materials at the same time to deposit compound materials
- system typically has several crucibles for depositing more than one material without breaking vacuum

ex:



③ Chemical Vapor Deposition (CVD)

→ solid thin films deposited on a wafer by vapor condensation or by adhesion of solid-phase reaction byproducts

→ reaction energy provided by heat or plasma power

Low-Pressure Chemical Vapor Deposition (LPCVD)

→ Heat energy at low pressure (~ few hundred mTorr) {770 Torr = 1atm}

→ 580° to 620°C + Silane gas (SiH_4) ⇒ polysilicon deposition

→ below 580° + SiH_4 ⇒ amorphous Si deposition

→ 800°C + SiH_4 {or dichlorosilane : $SiCl_2H_2$} + ammonia (NH_3) → Silicon Nitride (Si_3N_4) or Si_xN_y can occur

→ 500°C + SiH_4 + O_2 → SiO_2 {undoped → called Low Temp Oxide (LTO)}

→ if phosphorous doped with phosphine (PH_3) the glass is called phosphosilicate glass (PSG)

↓ etches faster in HF than LTO

↳ etch rate > 1μm/min