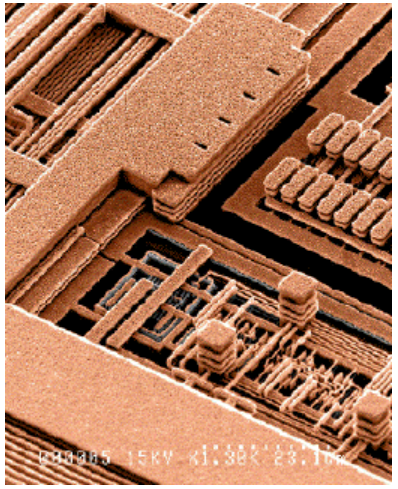
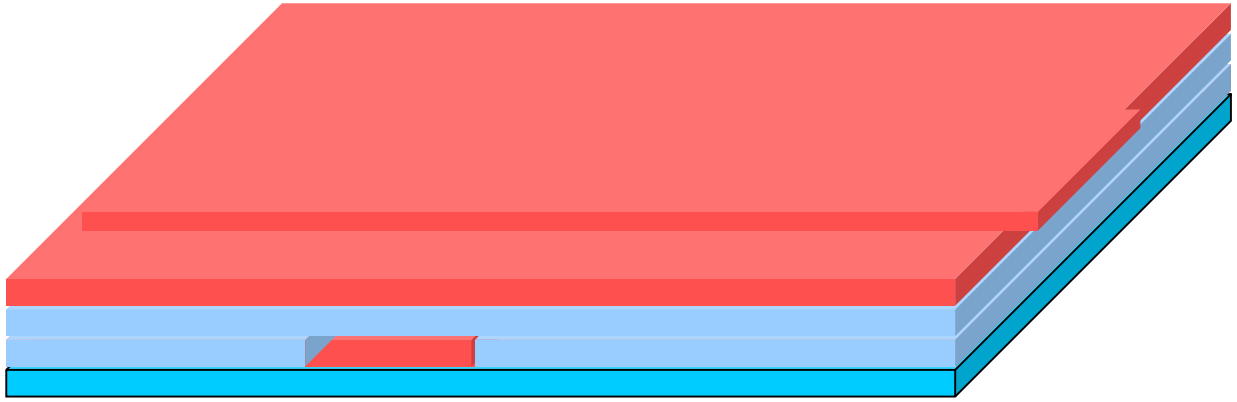
Thin Film Deposition

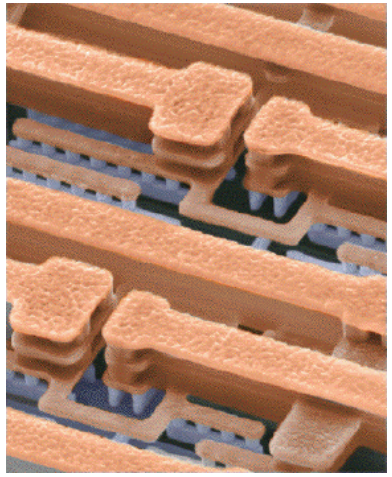
- Any technologies available to deposit thin layers of material onto a substrate of different material.
- Such technologies are used to achieve the desired properties of the thin film without affecting the bulk properties of the substrate.
- Thin film deposition belongs to the larger area of surface coating technologies & phenomena as it alters & improves the properties of the substrate material by treating the surface only for the deposited film properties & highly cost effectiveness.
- For example, a steel cutter but can be hardened by diamond coating or a steel drill bit hardened by titanium coating.
- The applications can only be limited by material science or our imagination.

Thin Film Deposition

With the help of photolithography & etching, many layers can be deposited & patterned on top of each other in IC fabrication.







Thin Film Deposition Techniques

Categorized into Physical Vapour Deposition (PVD) & Chemical Vapour Deposition (CVD).

PVD Techniques:

- Evaporation
- Sputtering

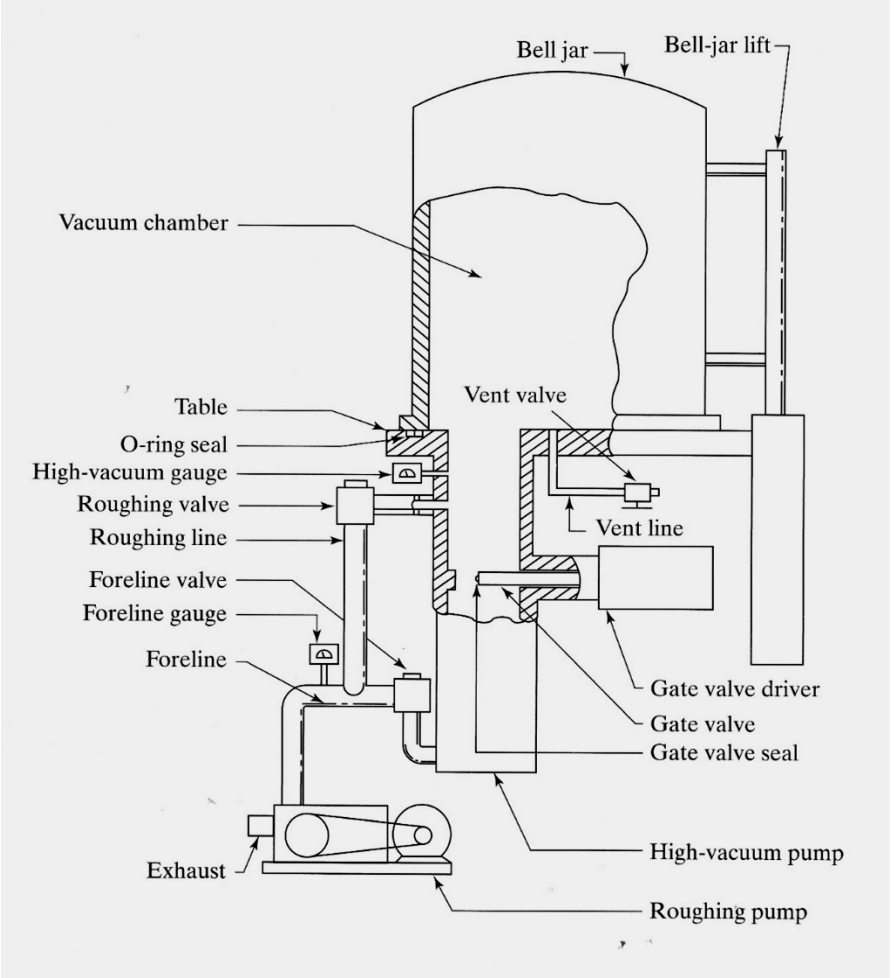
CVD Techniques:

- Atmospheric Pressure CVD (APCVD)
- Low Pressure CVD (LPCVD)
- Plasma Enhanced CVD (PECVD)

Electron Beam Evaporation

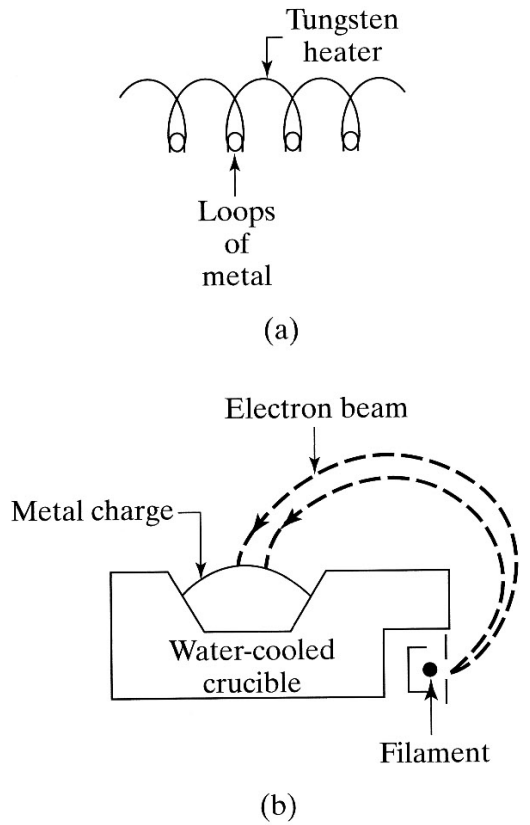
Evaporation

- Vacuum process.
- Involves heating of materials to the point of vaporization.
- The evaporated material vaporizes, transported by line of sight to & solidifies on the substrate.
- It follows the 2R (2x Radius) & 1R circumference for uniformity & perpendicular deposition respectively (to be covered in Advanced Wafer Fabrication Technology).



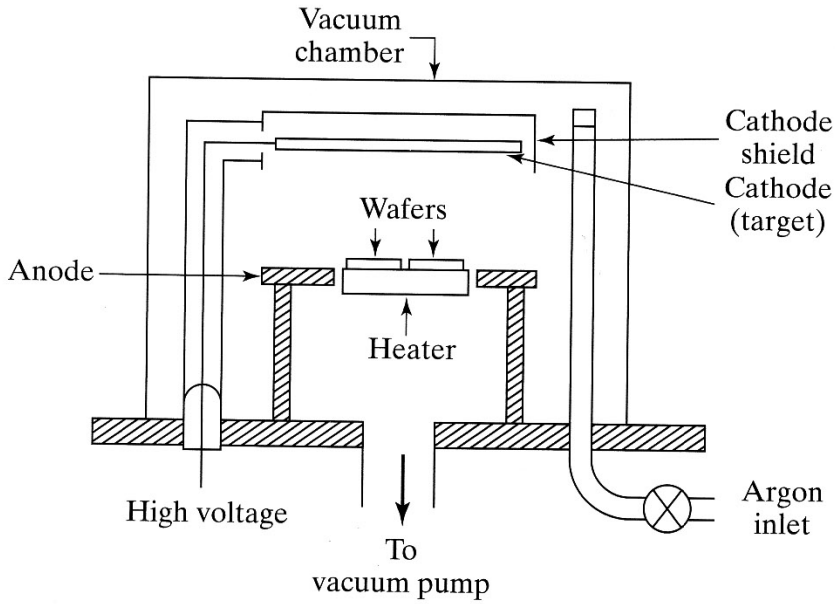
Electron-Beam Evaporation

- Tungsten heater or high-intensity electron beam (EB Gun) is used to heat up the material.
- EB is preferred method for IC as there is no contamination from the tungsten filament. Tungsten heating evaporation only good for metal & non-metals of low melting point & use in car lights & decorative coatings
- Only EB can be used to evaporate metal or dielectrics with high melting point.



Sputtering

- Vacuum process.
- Plasma (ionised gas) of argon by Magnetron (Combine Electric & Magnetic Field).
- Argon ions bombard the Target (material to deposit) to knock out & dislodge the atoms at the surface.
- Ejected atoms deposit on the substrate.
- Conductive materials use DC or RF power source.
- Non conductive materials can only use RF power source



Ion Beam Sputtering to be covered in Advanced Wafer Fabrication Technology

Sputtering

Depending on the configuration for differing advantages & disadvantages based on placement of the Target & Substrate:

- Down Sputtering
- Up Sputtering
- Side Sputtering

EB Evaporation versus Sputtering

EB Evaporation

- Uniformity only with planetary design (to be covered in Advanced Wafer Fabrication Technology).
- Moderate film density, stress & adhesion.
- High deposition rate for metal & dielectrics
- Good directionality (so can do lift off technique)
- High material utilization
- Uses: laser optics, solar panels, optical coatings & lift off technique for MEMS (to be covered in Advanced Wafer Fabrication Technology)

Sputtering

- Excellent uniformity without need for planetary design
- Good film density, stress & adhesion
- High deposition rate for metals only
- Low directionality (so cannot do lift off technique)
- High system cost & complexity
- Uses: media & DLC in HDD, specific optical & electrical properties