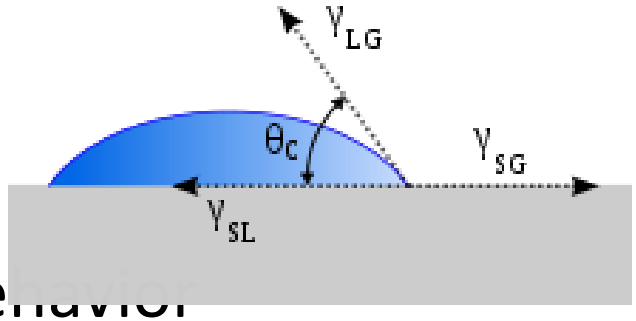
Evaluating and Monitoring of Cleaning

- Cleaning Tests
  - Sheeting
    - Water Break Test i.e. water sheet while rinsing is broken by hydrophobic contamination
  - Contact Angle
  - Nucleation
    - Black-Breath Test
  - Adsorption and Desorption behavior
  - Friction and Marking
    - Abrasive transfer if surface energy of surface is higher than that of marker e.g. indium writes on clean glass



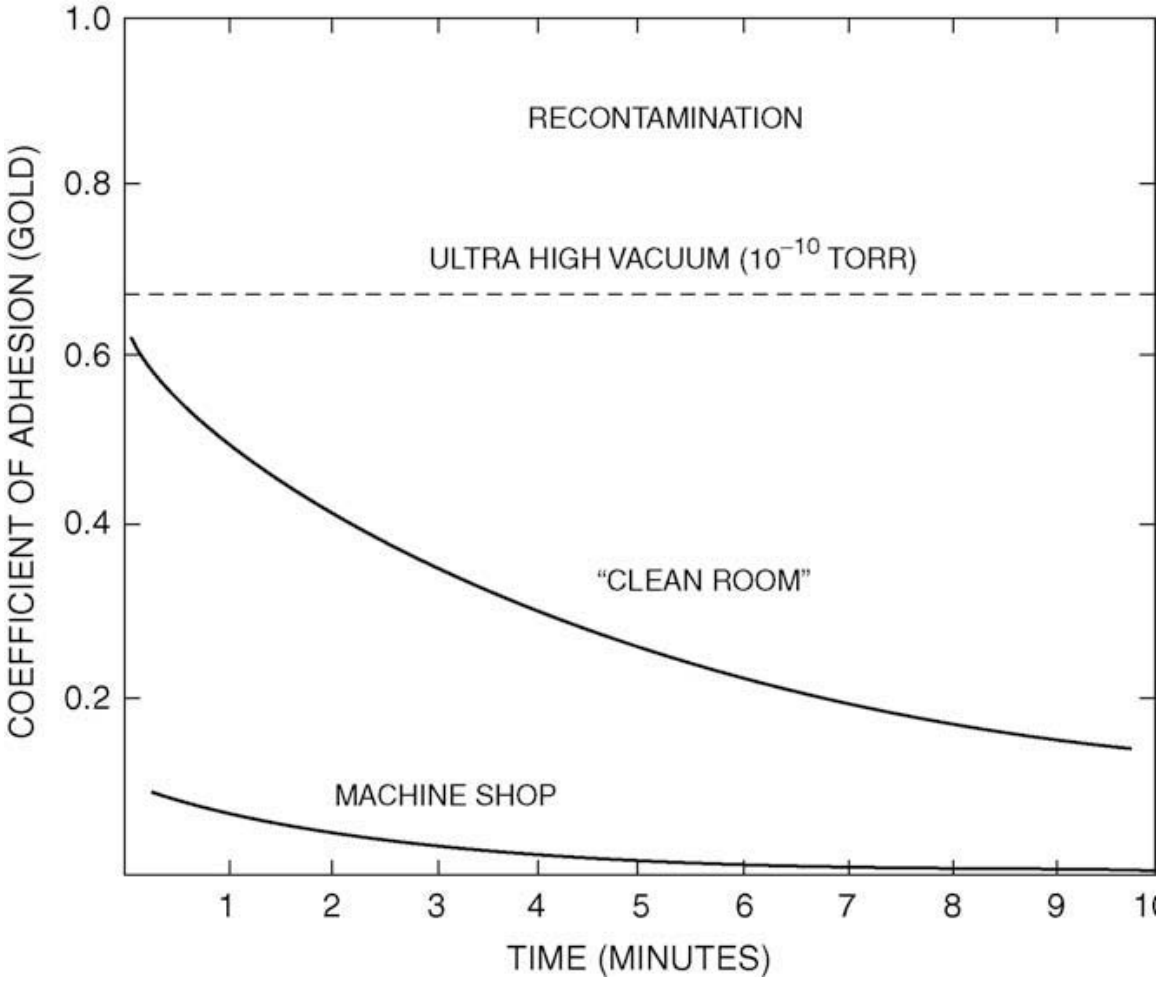
Evaluating and Monitoring of Cleaning

- Cleaning Tests
  - Surface Analytical Spectroscopy
    - AES
    - ISS
    - SIMS
    - XPS
      - Limited area analysis
        - Particle Detection on Smooth/Rough Surfaces
- Optical Microscope or Scanning Laser Microscope
  - 0.2-0.15 micron
  - Scanning Interferometry
  - Ultraviolet Luminescence
  - SEM
  - TEM

Recontamination in Ambient Environment

Ideally, cleaning lines need to be installed along with deposition stage e.g. CDs and Glass manufacturing

- Ambient Environment
  - –Adsorption of vapors
  - –Collection of particles
  - –Contact with surfaces
  - –Reaction with gases

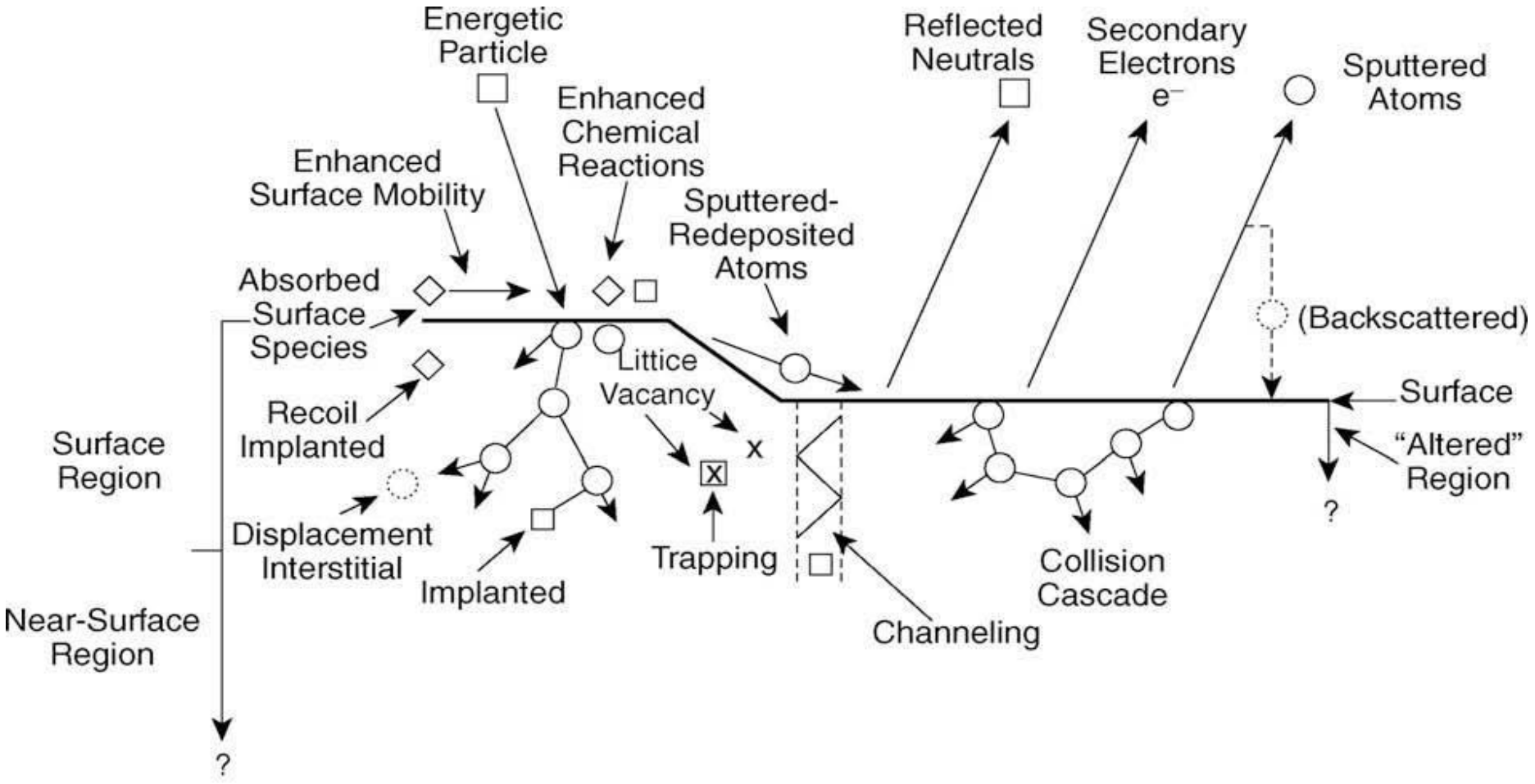


Recontamination in Ambient Environment

- Handling
- Storage
  - Passive
    - Petri dish
    - Al foil or Nylon fabric
    - Cleaned surfaces on each other
    - Under liquids e.g. metals in alcohol or acetone, in degassed water
    - Covering with liquid polymer and drying, stripping
  - Active
    - Contaminants are continually removed by adsorption or reaction
    - HC are removed by oxidizing atmosphere

In Situ Cleaning

- Sputter Cleaning: A universal etch



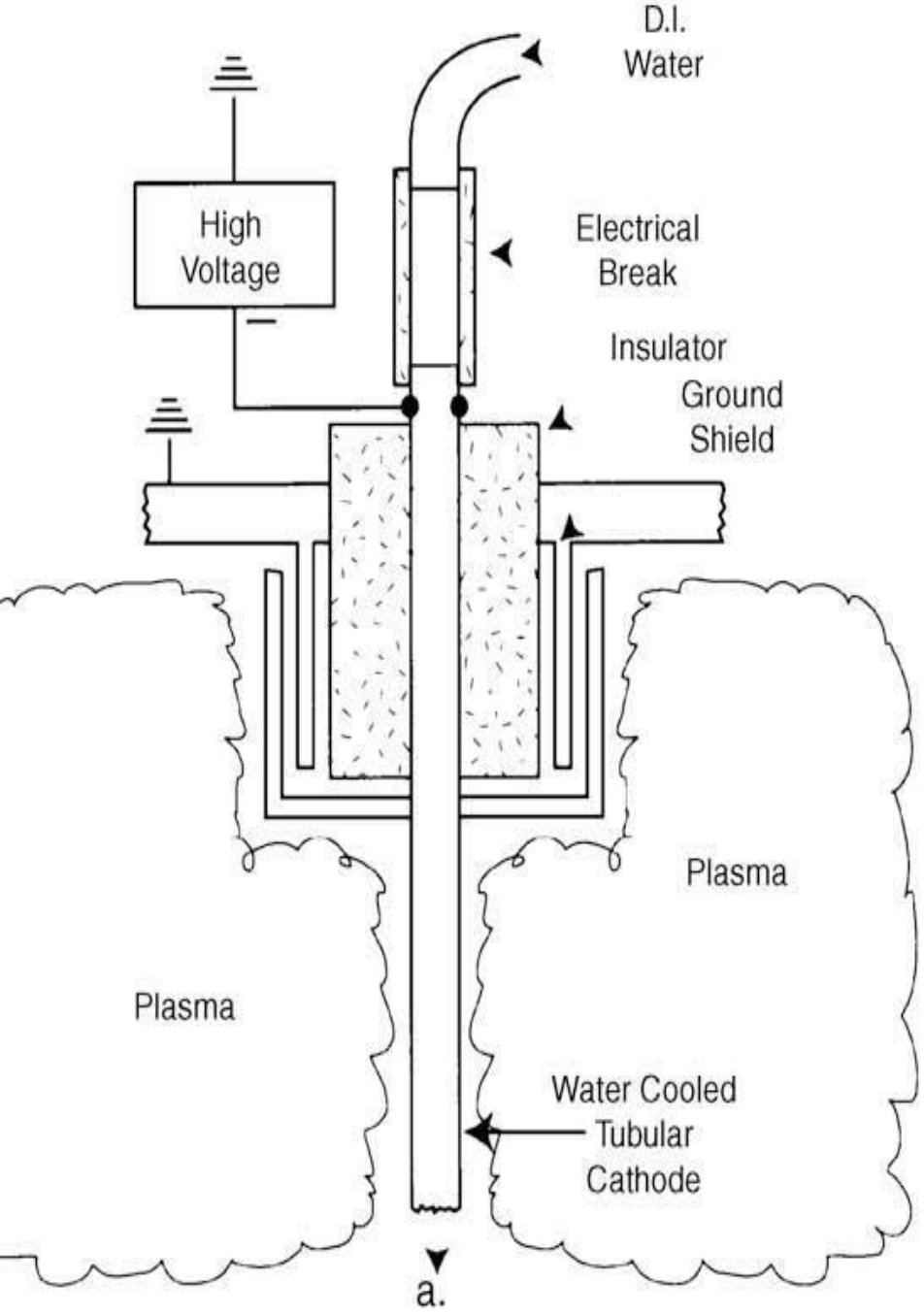
ENERGETIC PARTICLE BOMBARDMENT OF A SURFACE

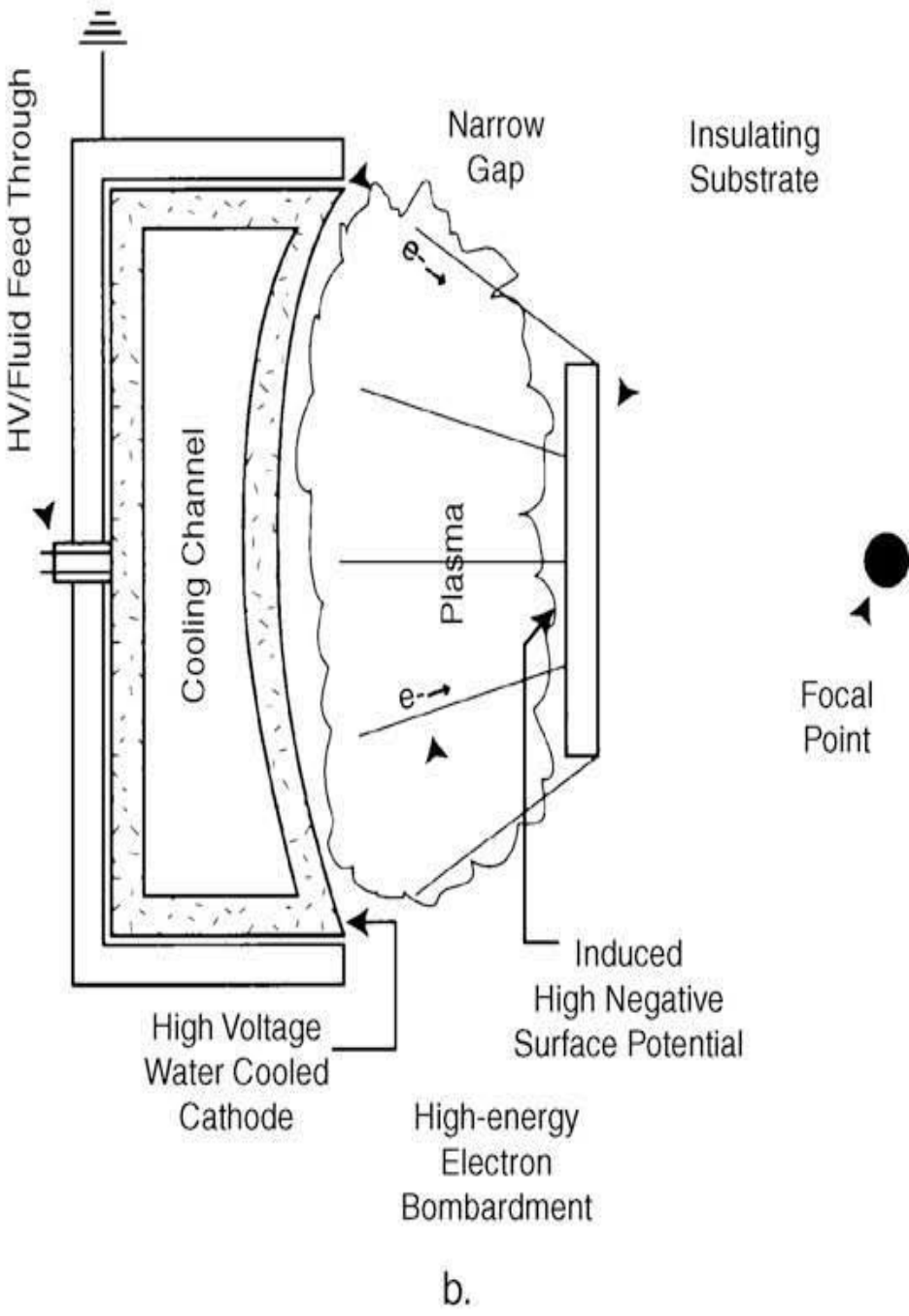
In Situ Cleaning

- Sputter Cleaning
  - Universal Etch i.e. everything can be removed
  - Conductive surface by DC.
  - RF field, a pulsed DC for Insulating surfaces
  - On heating the bombarded gas may be released if incorporated, cause loss of adhesion. Substrate can be heated while sputtering
  - Plasma environment: O_2 may be activated and react with surface. Ions from Ion Gun e.g Ar or O_2
- Ion Scrubbing
  - Surface makes a wall sheath and ions from plasma scrub the contaminants

In Situ Cleaning

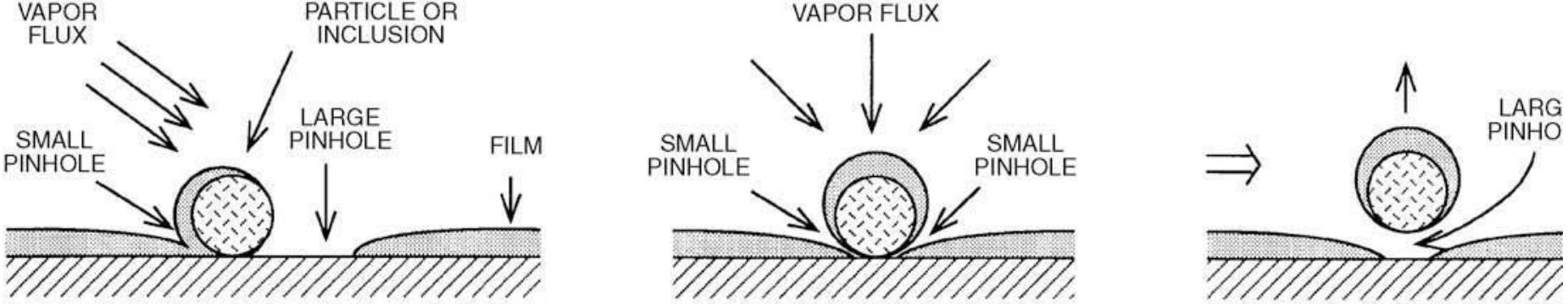
- Reactive Plasma Cleaning
  - Ion scrubbing but chemically
  - Glow Bar
    - High voltage cathode used for
      - Plasma cleaning on all surfaces
      - e^- bombardment on surfaces facing cathode
      - On an floating/insulating surface, e^- generates self bias accelerating ions to surface
  - H plasma to remove HC, CF_4 for SiO_x from Si
  - HCs volatilize as CO, CO_2 and H_2O
  - Residue e.g. SiO_2 from silicone oil from O plasma
  - H plasma, HCs are hydrogenated to more volatile


D.I.
Water
High
Voltage
Electrical
Break
Insulator
Ground
Shield
Plasma
Plasma
Water Cooled
Tubular
Cathode
a.


HV/Fluid Feed Through
Narrow
Gap
Insulating
Substrate
Cooling Channel
Plasma
e-
e-
Focal
Point
Induced
High Negative
Surface Potential
High Voltage
Water Cooled
Cathode
High-energy
Electron
Bombardment
b.

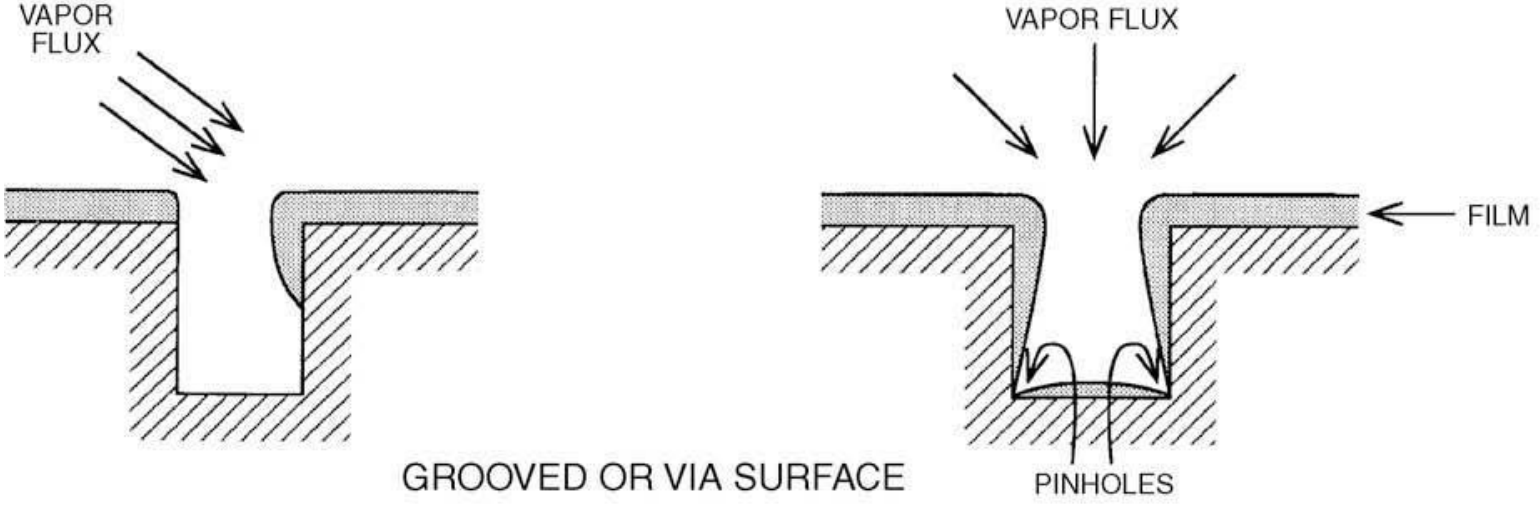
Recontamination in the Deposition System

- Pinhole flaking of deposited film material on walls
- Wear debris from surfaces in contact
- Debris from maintenance and installation
- Unfiltered gas lines
- Particulates brought in with fixtures and substrates
- Particulates brought in with gases and vapors
- Particulates formed by gas-phase nucleation of vaporized material



SURFACE BUMP

ROUGH SURFACE



GROOVED OR VIA SURFACE

Groov/Surface

Recontamination in the Deposition System

- Pinhole flaking e.g. $TaSi_2$
  - Occasionally overcoat with a softer material e.g. Al
  - Use dry lubricants e.g bolts should be silver plated
  - HC vapors-check by contact angle on clean glass plate, water vapor(highly polar so strongly adsorbed and stays on surfaces longer
    1. Backfilling with a dry gas
    2. Reducing the exposure time to atmosphere
    3. Flow of dry gas when open
    4. Keep walls warm
    5. Dry and warm the surfaces before introducing into the system
    6. LN_2

Surface Modification Processes

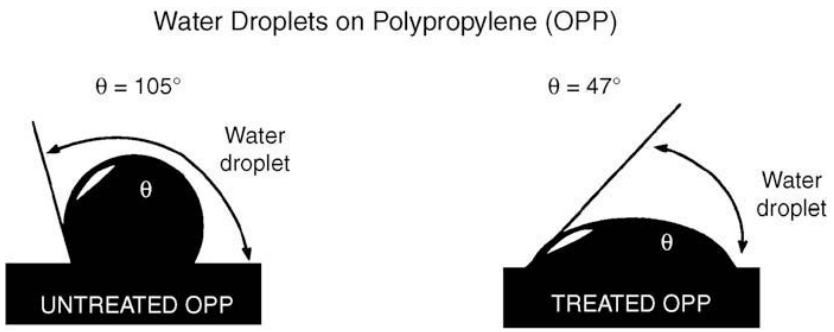
- Ex Situ Surface Modification
  - Basecoat
    - Polymer basecoat for flowcoat and smoothing as well as to seal in materials against outgas and outdiffuse
    - Inorganic basecoat of Diamond Like Carbon to enhance scratch resistance
  - Surface Chemistry
    - Flame treatment, Corona treatment, Plasma treatment for
    - Polymer surfaces: increase surface energy or modify functional groups
  - Surface Hardness (Diffusion hardness)
  - Surface Barrier Layers
    - Na diffuses out to layers of soda lime glass, Silica layer is made as Barrier

Surface Modification Processes

- In Situ Surface Modification
  - –PIIID (Plasma Immersion Ion Implantation Deposition)

a metallic cathode is immersed in plasma and pulsed momentarily to high voltage(50-100 kV)

- Plasma anodizing-growing a very coherent oxide layer on metal compounds and Si
- Plasma changes the functional groups on the surface of polymer and changes the surface energy making it more acidic or basic resulting change of contact angle



EFFECT OF CORONA TREATMENT ON WETTING

Thin Film Physics

Surface Preparation for Thin Films
External Cleaning, In-Situ Cleaning,
Deposition Methods