Multilevel Interconnects

Nonplanar Metallization

Planar Metallization
Surface Planarization

• Benefits for Lithography Processes:
  – Lower Depth-of-Focus requirement for lithography
  – Reduced optical reflection effects on resist profiles
  – Reduced resist thickness variation over steps

  ![Image of linewidth variation](https://en.wikipedia.org/wiki/Chemical-mechanical_planarization)

• Benefit for Etching Processes:
  – Reduced over-etch time required due to steps

• Benefit for Deposition Processes:
  – Improved step coverage for
  – subsequent layer deposition

Chemical Mechanical Planarization (CMP)

• Wafer is polished using a slurry containing
  – Silica abrasives (10-90 nm particle size)
  – Etching agents (e.g. dilute HF)

• Backing film provides elasticity between carrier and wafer

• Polishing pad made of polyurethane, with 1 mm perforations
  – Rough surface to hold slurry

https://en.wikipedia.org/wiki/Chemical-mechanical_planarization
CMP Rate

Preston Model:

- Local Removal rate \( R = K_p P v \)
  where
  - \( K_p \) = Preston coefficient [unit in pressure\(^{-1}\)]
  - \( P \) = local applied pressure
  - \( v \) = relative pad-wafer velocity

- \( K_p \) is a function of film hardness, Young’s modulus, slurry, pad composition and structure

Problems Encountered in CMP

[Diagrams of non-uniformity, rounding, and dishing]