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CHE323/CHE384
Chemical Processes for Micro- and Nanofabrication
www.lithoguru.com/scientist/CHE323

Lecture 22
Sputtering, part 1

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Reading:
Chapter 12, *Fabrication Engineering at the Micro- and Nanoscale*, 4th edition, Campbell

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Sputtering

- Sputtering largely solves the problems with evaporation
- Now the dominant technique for most metal deposition, and some dielectrics
- Similar to plasma etch systems (to be discussed later), but we are etching the target rather than the wafer

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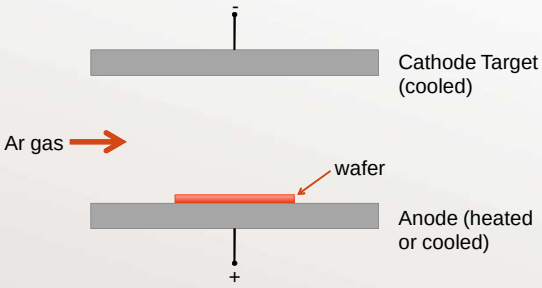
Sputtering System



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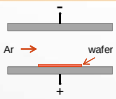
Sputtering Systems



- Argon used as sputter gas due to low reactivity (and thus high sputter yield)
- Create a plasma using DC (for metals) or RF (for dielectrics) power
- Ar^+ accelerated to target (made of metal/alloy/dielectric of interest)
- Ar^+ sputters off target material, which then randomly lands on wafer and sticks

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Pressure

- Argon gas pressure at ~ 0.1 torr
- Resulting mean-free path $\lambda \approx 0.5$ mm
- Many collisions take place as sputtered target material travels to the wafer
- Material arrives at wafer from all angles
  - Good step coverage
  - Still some shadowing

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Sputter Yield

- Sputter yield is defined as

$$Sputter\ Yield = \frac{\#\ of\ target\ atoms\ released}{\#\ of\ ions\ hitting\ target}$$

- If ion energy < 10 – 100 eV, there is no sputtering (yield = 0)
- If ion energy > 10 keV, we get implantation
- We try to get sputter yields between 1 and 2

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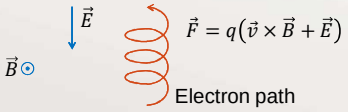
Magnetron Sputtering

- Apply a magnetic field parallel to wafer (perpendicular to electric field)
  - Electrons will spiral around the magnetic field
  - Increased path length means more ionization
  - Result: high density plasma



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Lecture 22: What have we learned?

- Describe the basic components of a sputter system
- How is good step coverage achieved in a sputtering system?
- Define “sputter yield”
- Explain the operation and effects of magnetron sputtering

