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

Lecture 35
Etch, part 2

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Reading:
Chapter 11, *Fabrication Engineering at the Micro- and Nanoscale*, 4th edition, Campbell

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Sputter Etching

- Like sputter deposition, but put negative bias on the wafer instead of target
- Use low-pressure Ar^+ ions
  - Keep mean free path large compared to plasma-wafer distance
- Use both RF power (to create plasma, control ion concentration) and DC bias (to control energy of sputtering)

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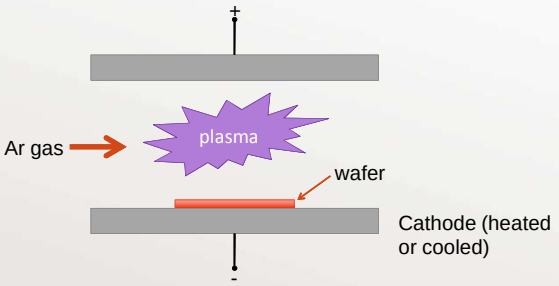
Sputtering System



RF frequency = 13.56 MHz

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Sputter Etching

- Natural bias voltage (~10V or more) develops because electrons are more mobile than ions
  - Plasma develops + voltage
- Sheath (dark) region develops next to electrodes (0.1 – 10 mm thick)
  - Plasma glows because of electron collisions with gas molecules
  - All voltage drop is across the sheath

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Sputter Etching

- Argon sputter etching is a purely physical process
  - Anisotropy ~ 1
  - Selectivity ~ 1
- To get more selectivity we need chemistry
  - Add reactive species into the plasma
- To get high etch rates we need high concentrations
  - Higher pressures mean smaller mean free path

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Plasma Etching

- Add reactive species to the plasma
- Results in both ions and free radicals (reactive neutrals)
- Higher pressures produce greater etch rates
- Result: High selectivity, low anisotropy
  - Like wet chemical etching

Mix of Sputter and Plasma Etching

- By adjusting gas constituents and flow rates, and RF power and DC bias, we can get a mix of chemical etching and physical (sputter) etching
  - Medium selectivity
  - Medium anisotropy
- How can we achieve both high selectivity and high anisotropy?

Lecture 35: What have we learned?

- Describe the components of a sputter etch system
- How does sputter etching achieve high anisotropy, and why is its selectivity low?
- How is plasma etching different from sputter etching?
- How does plasma etching achieve high selectivity, and why is its anisotropy low?

