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Dry Etching

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Dry Etching

- Physical sputtering
- Plasma etching
- Reactive ion etching

All based upon plasma processes.

(+) ions generated by inelastic collisions with energetic e^{-1} 's
 Get avalanche effect because more e^{-1} 's come out as each ion is generated.

RF (also, could be μ wave)

Develop (-) bias

Plasma (partially ionized gas composed of ions, e^{-1} 's, and highly reactive neutral species)

E-field

wafer

Develops (+) charge to compensate for -

\therefore (+) ions will be accelerated to the wafer

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Physical Sputtering (Ion Milling)

- Bombard substrate w/ energetic ions \rightarrow etching via physical momentum transfer
- Give ions energy and directionality using E-fields
- Highly directional \rightarrow very anisotropic

ions

plasma

PR

PR

film

Si

Steep vertical wall

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Problems With Ion Milling

PR etched down to here

PR

PR

PR

film

Si

Once through the film, the etch will start barreling through the Si

- PR or other masking material etched at almost the same rate as the film to be etched \rightarrow very poor selectivity!
- Ejected species not inherently volatile \rightarrow get redeposition \rightarrow non-uniform etch \rightarrow grass!

- Because of these problems, ion milling is not used often (very rare)

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RIE: Surface Damage Mechanism

- Relatively high energy impinging ions (>50 eV) produce lattice damage at surface
- Reaction at these damaged sites is enhanced compared to reactions at undamaged areas

Result: E.R. at surface >> E.R. on sidewalls

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RIE: Surface Inhibitor Mechanism

- Non-volatile polymer layers are a product of reaction
- They are removed by high energy directional ions on the horizontal surface, but not removed from sidewalls

(+) ions breakup the polymer layer

Result: E.R. @ surface >> E.R. on sidewalls

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