

## Photolithography I

- Without photolithography there would be no integrated circuits because every process done to a wafer to fabricate diodes and transistors (implantation, oxidation, diffusion, and etching), would be done to the whole surface of the wafer. We would be limited to diodes and MOS capacitors the size of the wafer (Yes we could cut the wafer up into parts, but this is quite limited.)

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## Photolithography

- Our Process:
  - Singe
  - Spin on photoresist
  - Pre-Bake
  - Expose
  - Develop
  - Post-Bake
  - Etch
  - Remove photoresist

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## Singe

- What is it?
  - Heat wafers to about 800 °C for five minutes in.
- Why do we do it?
  - SiO<sub>2</sub> and Si attract water and absorb it.
  - Photoresist repels water, thus if the SiO<sub>2</sub> or Si have absorbed water, the photoresist will not stick.
  - We can also ash particles on the wafers.

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## Spin on photoresist

- What is it?
  - Photoresist is a photosensitive film that can be selectively patterned, and can protect the underlying structures from your etch process. It is a polymer that contains an interlocking mechanism, photosensitive chemicals, and solvents.
- Why do we spin it on?
  - Spinning it on is the quickest way to uniformly coat the wafer with photoresist.
  - It also dries out the solvent from the PR.

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## Spin on photoresist

- Problems?
  - Most of the PR is spun off the wafer. PR is about \$900 per gallon.

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## Pre-Bake

- What is it?
  - Bake the wafers for 90 °C for 30 minutes.
- Why do we do it?
  - Drive out solvent
    - Convert liquid to solid
  - Relieve stress during spin on step
- It needs to be carefully optimized with exposure time. Too much softbake and the film will not be very sensitive to the developer. Too little and the film will be too sensitive.

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## Expose

- What is it?
  - Selectively expose the PR coated wafers with UV light with a predetermined amount of energy.
- Why do we use UV light?
  - We can resolve features down to about  $\lambda/2$ .

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## Develop

- What is it?
  - Mechanically agitate the exposed wafers in a developer solution.
- Why do we do it?
  - This removes the PR that we do not want. We have a selective pattern on the sample that will protect features from etching.

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## Post-Bake

- What is it?
  - We post-bake at 120°C for 20 minutes
- Why do we do it?
  - This drives out all the elements that would allow the PR to be attacked by the etch.

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## Etch or Process

- Once we have completed these step we have to remove oxide so that we can diffuse n or p, implant or grow a different quality oxide on the wafer.
- Note: We are not able to diffuse or oxidize until we have removed the patterning PR.

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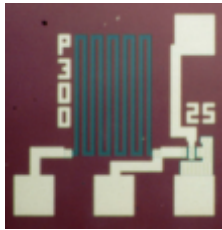
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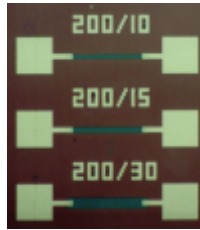
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## Our Devices:



PMOS INVERTER



Resistors

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