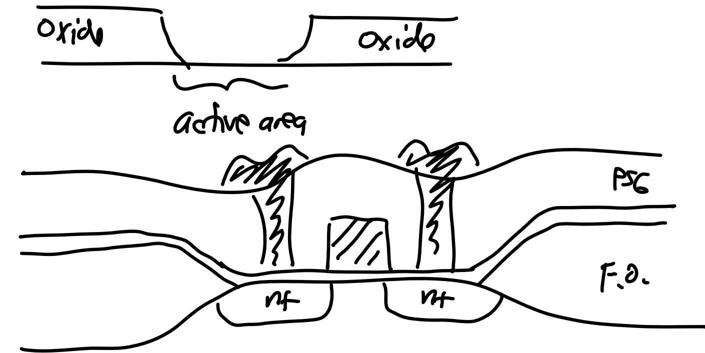
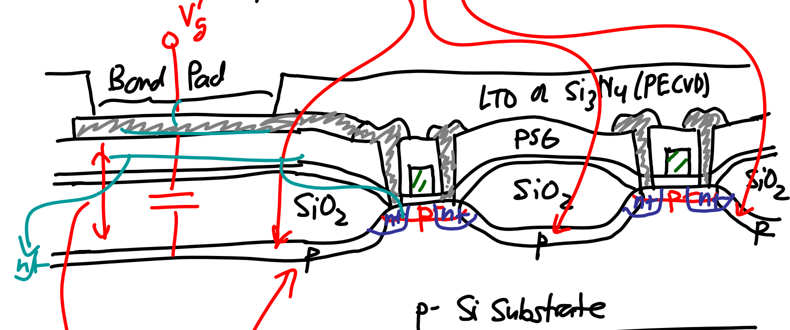
Lecture 7: Lithography I

- Announcements:
  - none
- ---
- Lecture Topics:
  - Masks & alignment
  - Lambda design rules
  - Four main components of lithography
    - Radiation source
    - Mask
    - Photoresist
    - Exposure system
  - Resolution
  - Linewidth control
  - Alignment accuracy
- ---
- Last Time:
- Go through the last lecture notes
- Emphasize:
  - Avoid high energy implant into photoresist, since too high an energy can heat the PR up and make it hard to remove
  - Redo the oxide over active area regions after the threshold implant, since the implanted oxide is damaged – this is why the gate oxide is regrown
  - p-type implant under the field oxide regions is there to prevent parasitic NMOS device under metal interconnect from turning on
  - LOCOS bird's beak helps to reduce topography in going from thin to thick oxide regions

In Lab: Isolation



What's with the p regions here?



① Make F.O. thick → raises the V_t' of the parasitic NMOS device

② Implant p → raises the V_t'!

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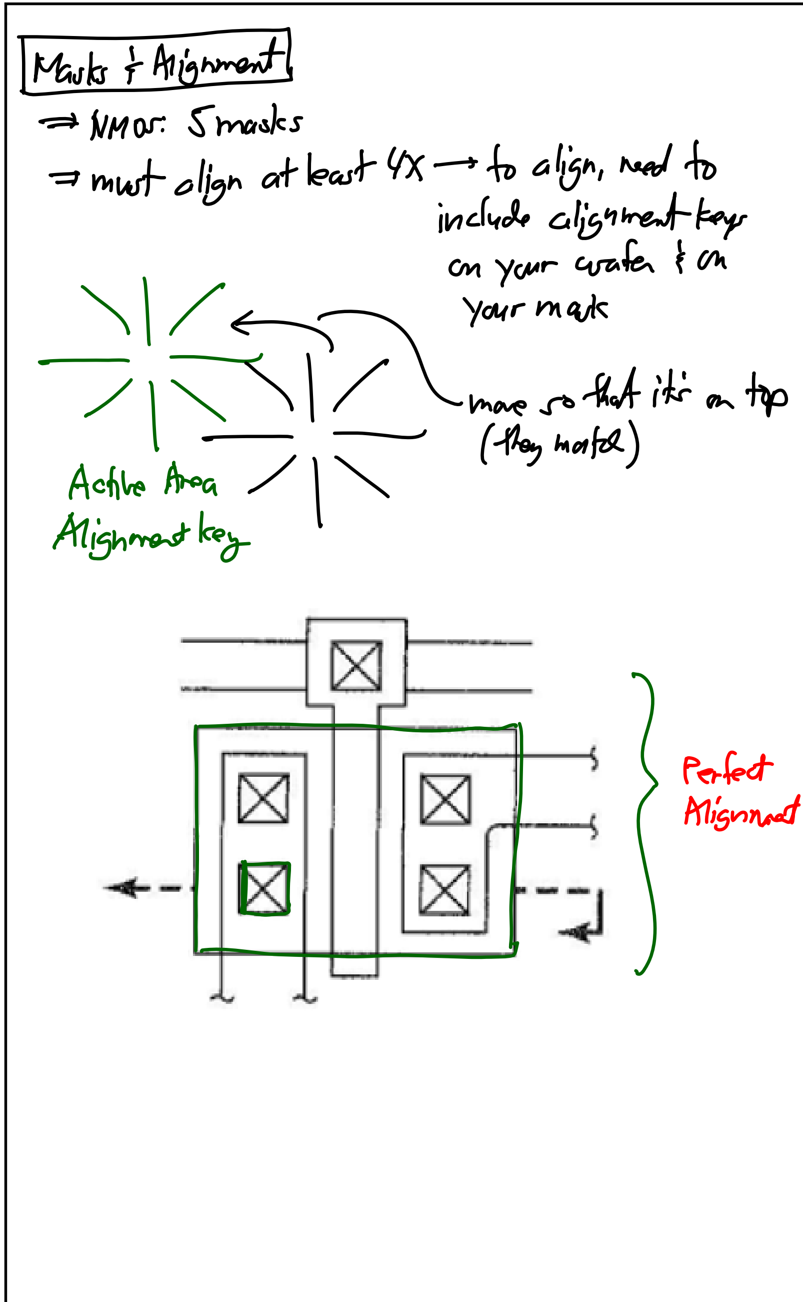

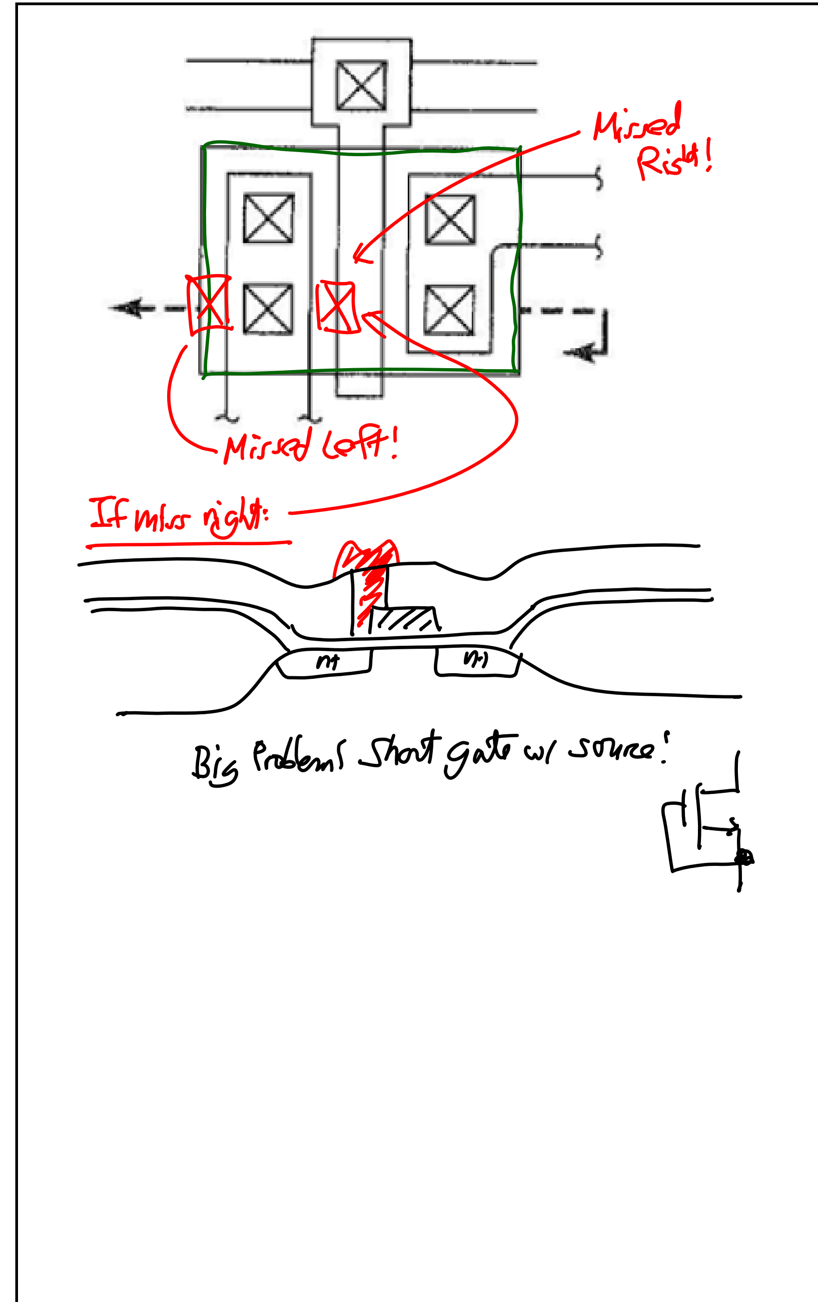

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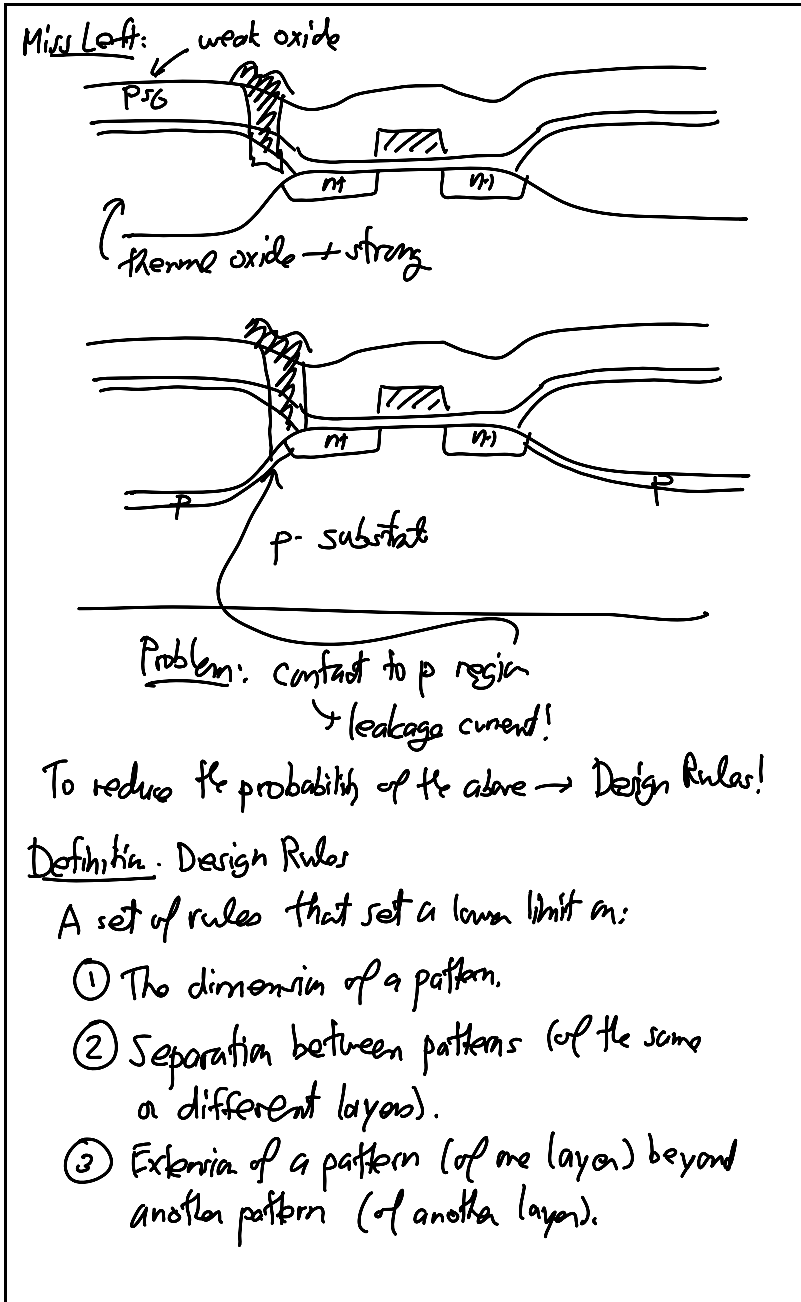

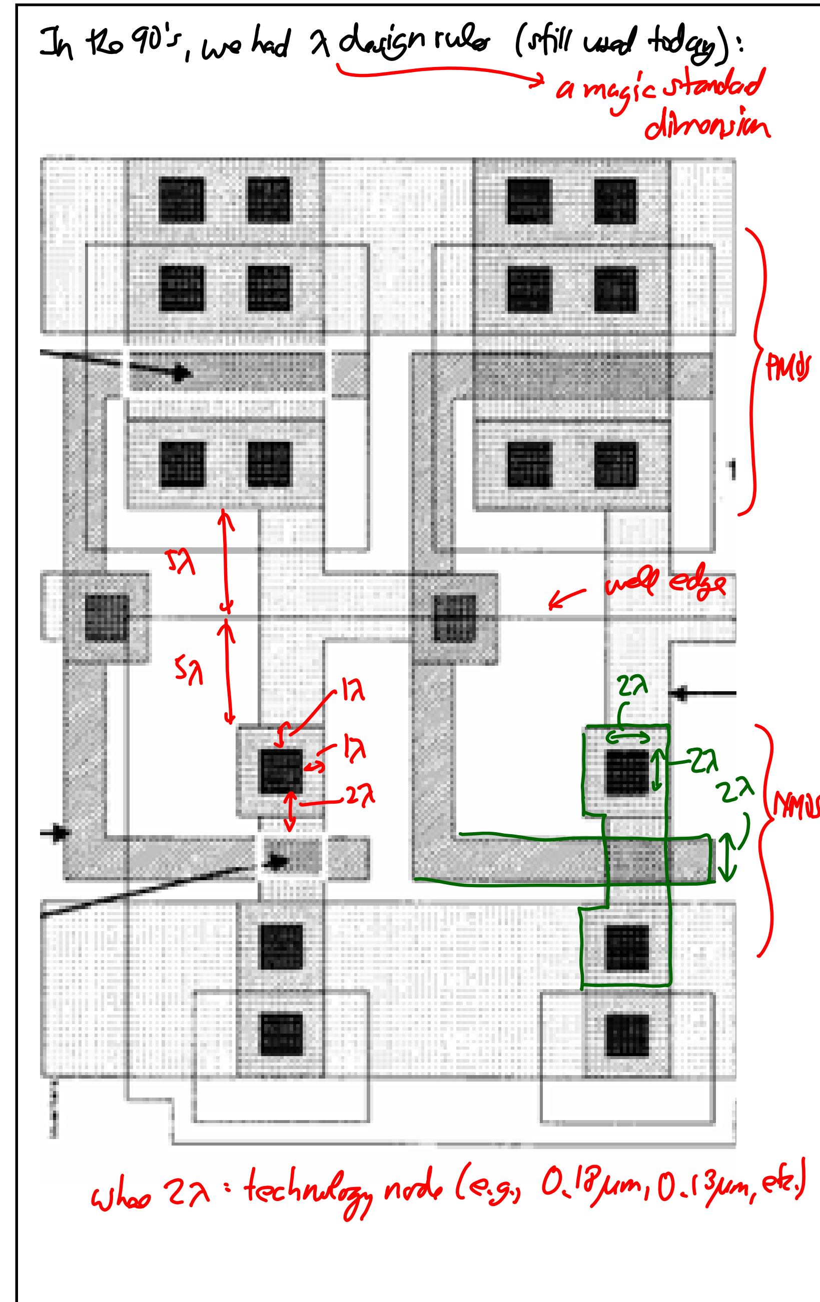

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What determines these rules?

gate poly

minimum dimension of contact

E_{AC} → Extension of Active Area (A) Beyond Contact (C)

D_c → limited by resolution of photolithography

E_{AC} = Alignment Error (layer-to-layer) ~ 0.5λ

+ Undercutting of Contact Hole (a size variation) → 0.3–0.5λ

+ Encroachment of Active Region (by the Bird's beak field oxide) (can be up to 1λ → this is why people today don't like LOCOS (for < 90 nm))

Which alignment key (a layer) to align to?

- Active Area (df)
- Gate Poly (cf)
- Contact (df)
- Metal (cf)
- Bond Pad Opening (df)

Lithography

→ method for massive patterning of features on a wafer → pattern billions of devices in just a few steps

Four Main Components: (that affect resolution)

I. Radiation Source

II. Mask

glass/quartz

photoresist

film to be patterned

III. Photoresist

IV. Exposure System

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