

Special Topics on Basic EECS I Design Technology Co-Optimization

Lecture 8

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L8

Selectively etch the mandrels.

- Without selectivity, we fail to get the wanted shape.
 - For selectivity, (just like a mask) define a model.

```
model (name="model_fin") {  
  select (region="AmorphousSilicon")  
}
```

- Selected regions are etched.
- At present, selection is binary.



Removal of the mandrels

- Try `etch (model="model_fin", thickness=50)`

- Now, only mandrels are removed.

- TMAH

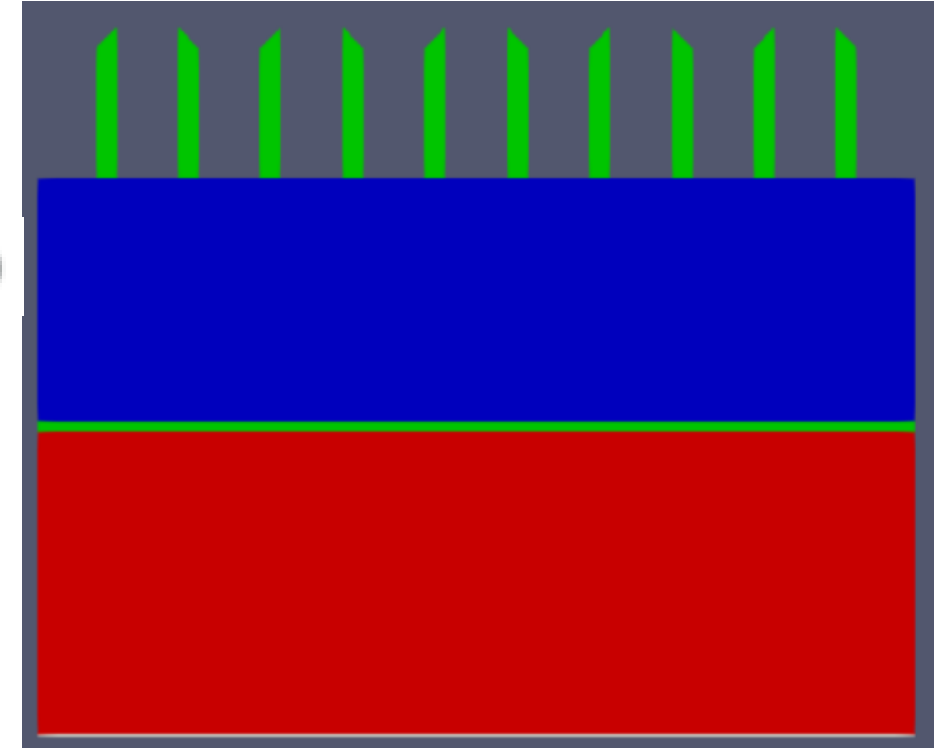
- (Tetramethyl ammonium hydroxide)

- Molecular formula: $\text{N}(\text{CH}_3)_4^+ \text{OH}^-$

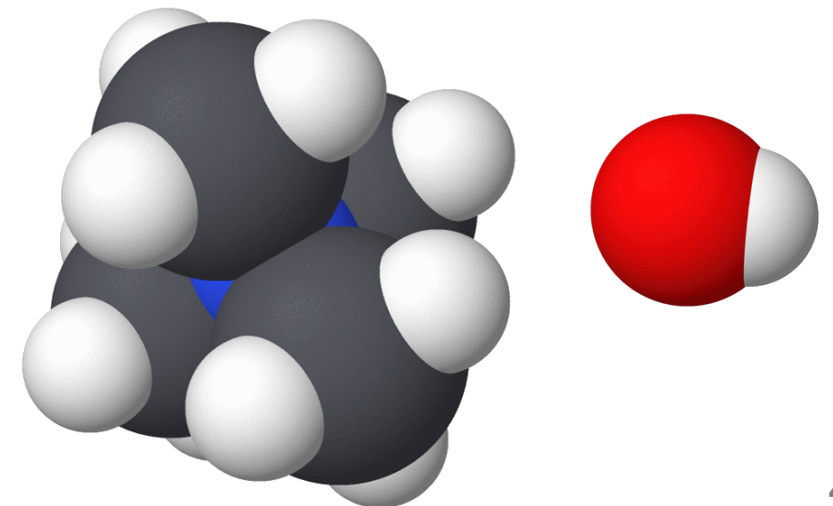
- Si (100): 500 nm min^{-1}

- Si_3N_4 : ~ 0

- SiO_2 : 0.2 nm min^{-1}



3D spacefill model
of TMAH (Wikipedia)



Spin-coat a layer of photoresist.

- We have no special comment for the spin coating.
 - Try the following:

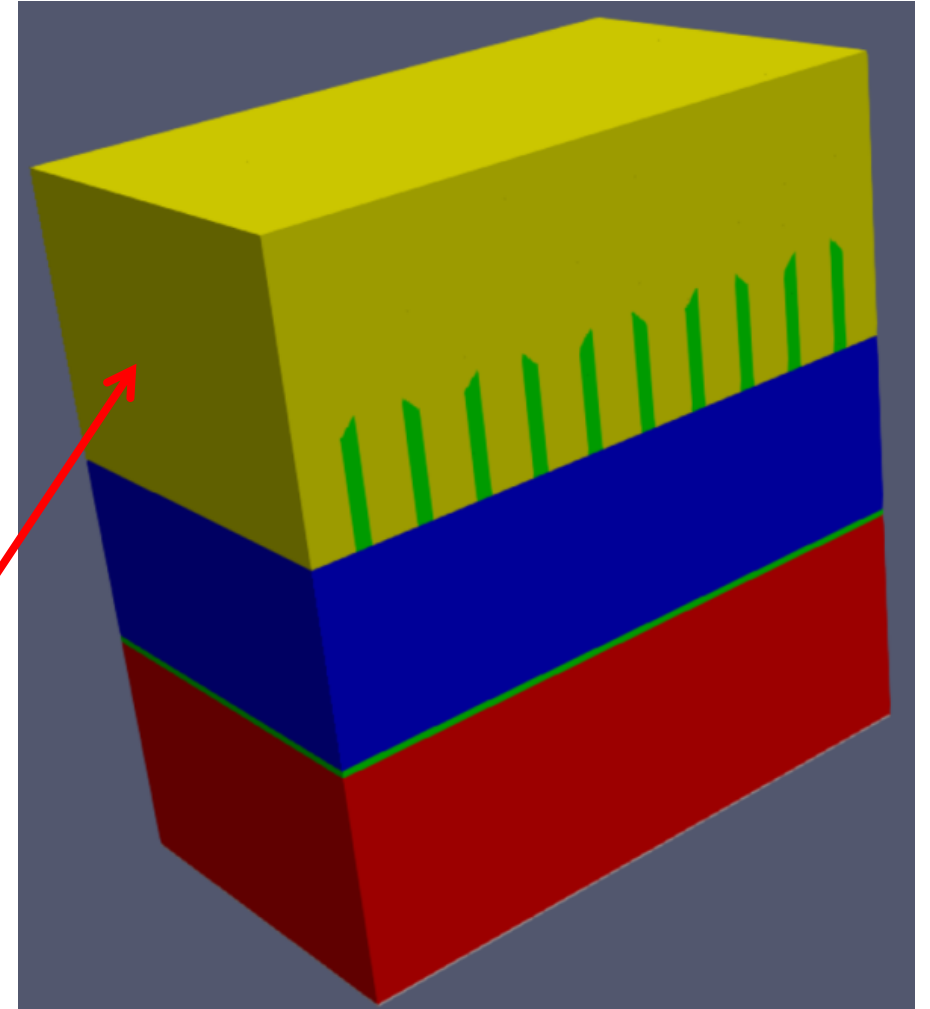
```
depo (region="Photoresist",thickness=120)
```

```
cmp (position=303)
```

(It's not deposition.)

(It's not cmp.)

Photoresist
(Not mandrel)

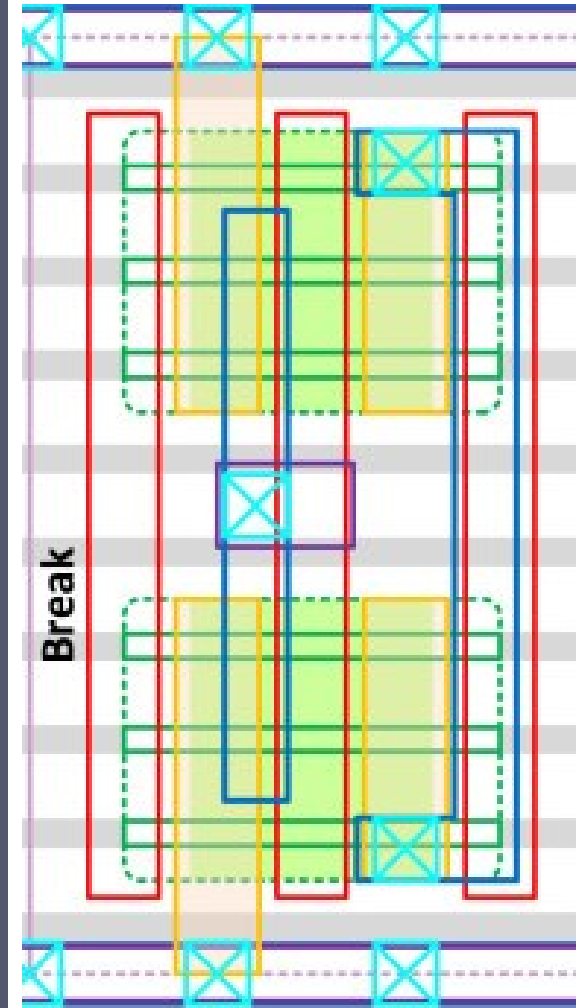
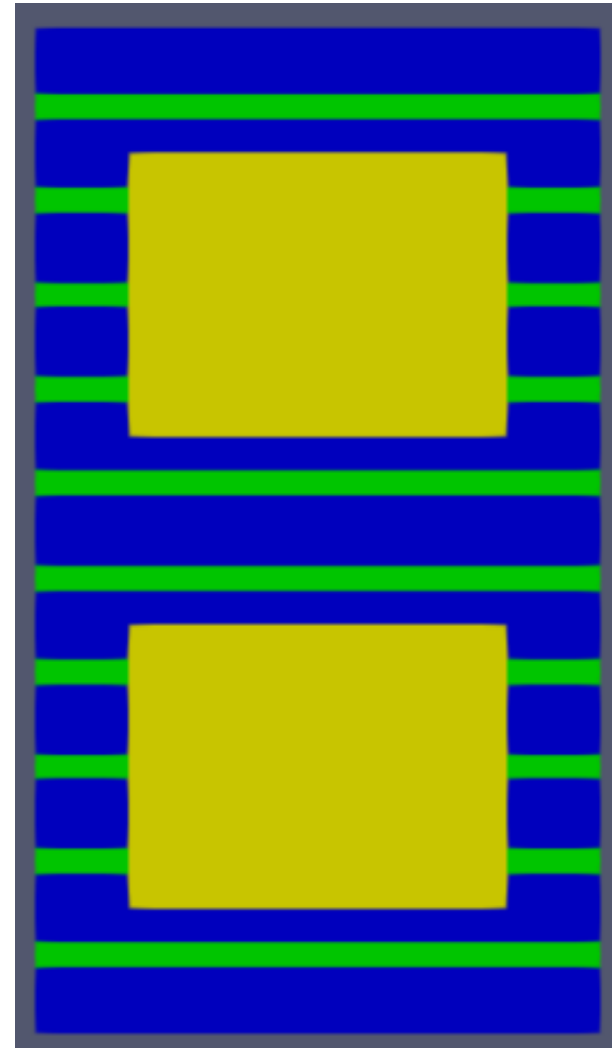


Active region

- PR patterned
 - Try the following:

```
mask (name="mask_active") {  
  rectangle (x0=27,y0= 36,x1=135,y1=117)  
  rectangle (x0=27,y0=171,x1=135,y1=252)  
}  
  
model (name="model_pr") {  
  select (region="Photoresist")  
}  
  
etch (mask="mask_active",model="model_pr",thickness=120)
```

- Then, etch SiO_2 and Si_3N_4 .
(In reality, they can have different etch rates.)



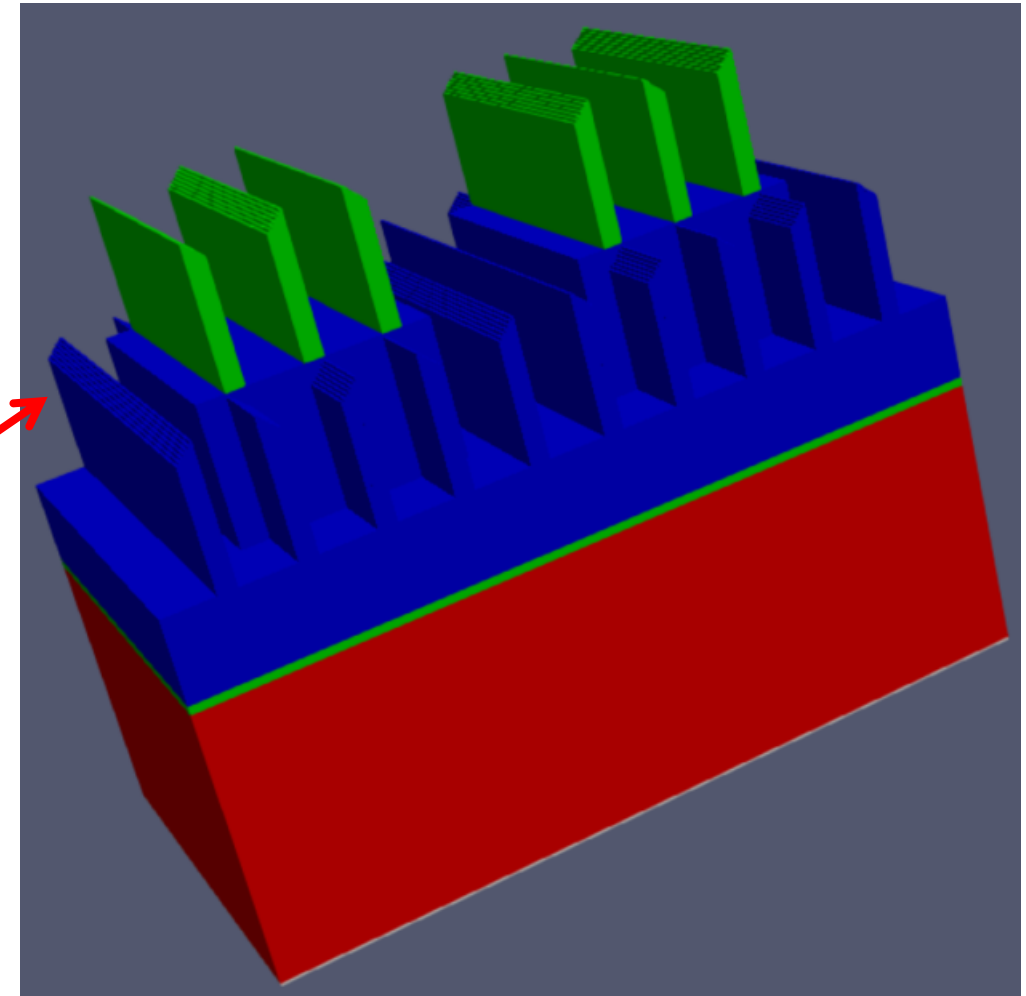
Inverter layout
(ASAP7 PDK)

Remaining pattern

- It should be transferred to the silicon region.

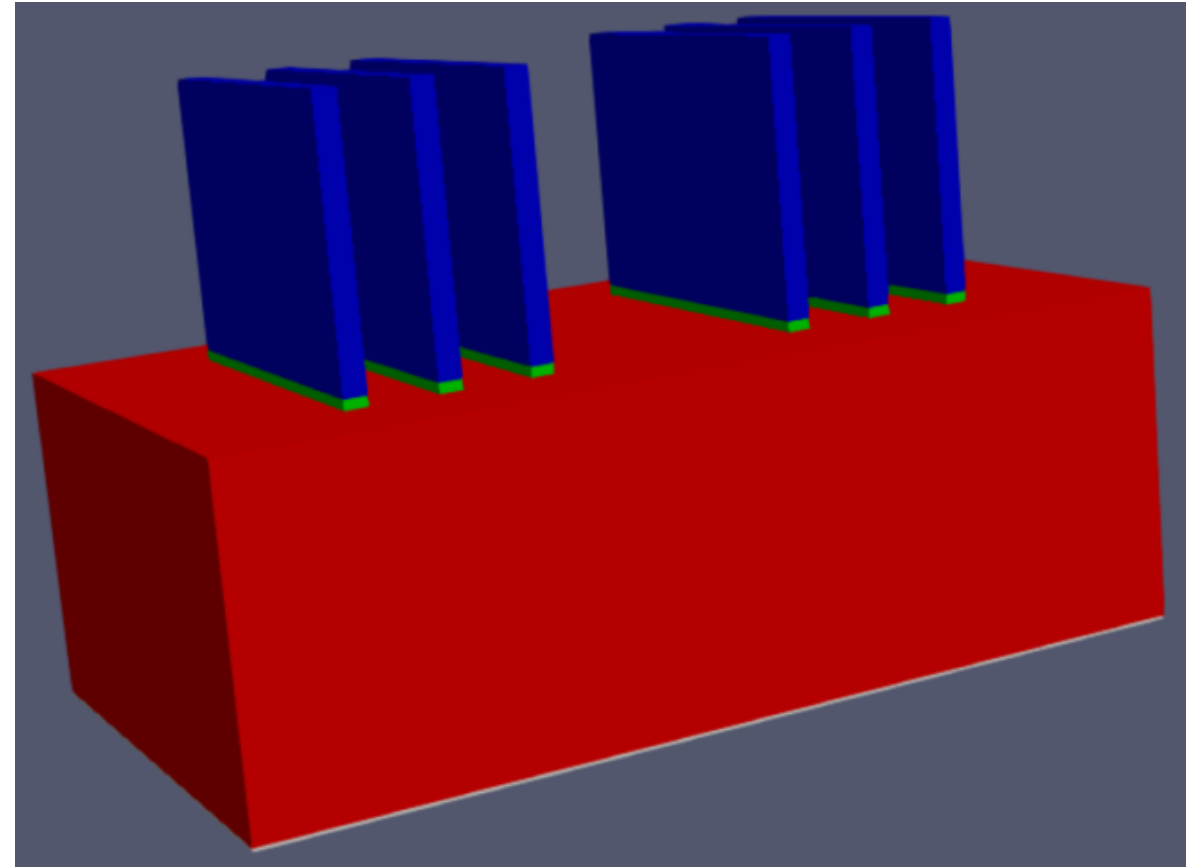
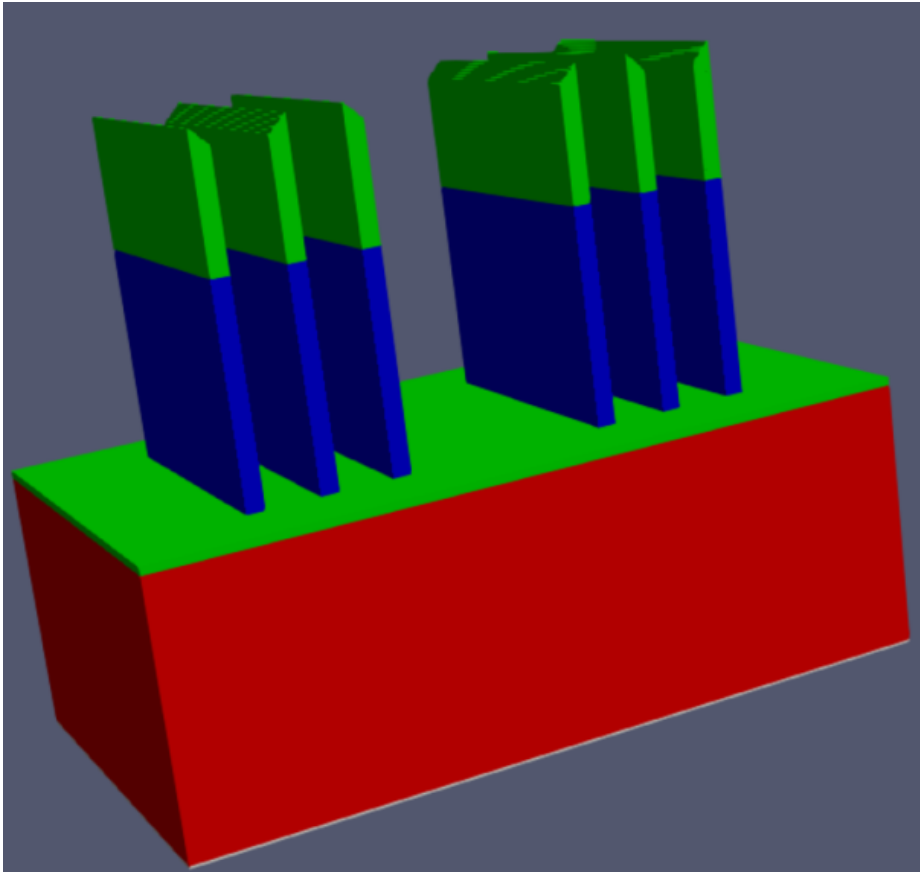
```
model (name="model_fin_block") {  
    select (region="SiO2")  
    select (region="Si3N4")  
}  
  
etch (model="model_fin_block",thickness=50)  
etch (model="model_pr",thickness=120)
```

Si_3N_4 surface obtained by the same etch rate
(In reality, it may be smoother.)



Etch only Si_3N_4 .

- Pad oxide as the etch stop layer
 - Then, remove the oxide layers.



Homework#8

- Due: 08:00 on Oct. 1
- Submit a report through the GIST LMS system.
 - By using the AngstromCraft code, follow L8 lecture material.
 - Your report must show structures and the input file.

Thank you!