Special Topics on Basic EECS I Design Technology Co-Optimization

Lecture 7

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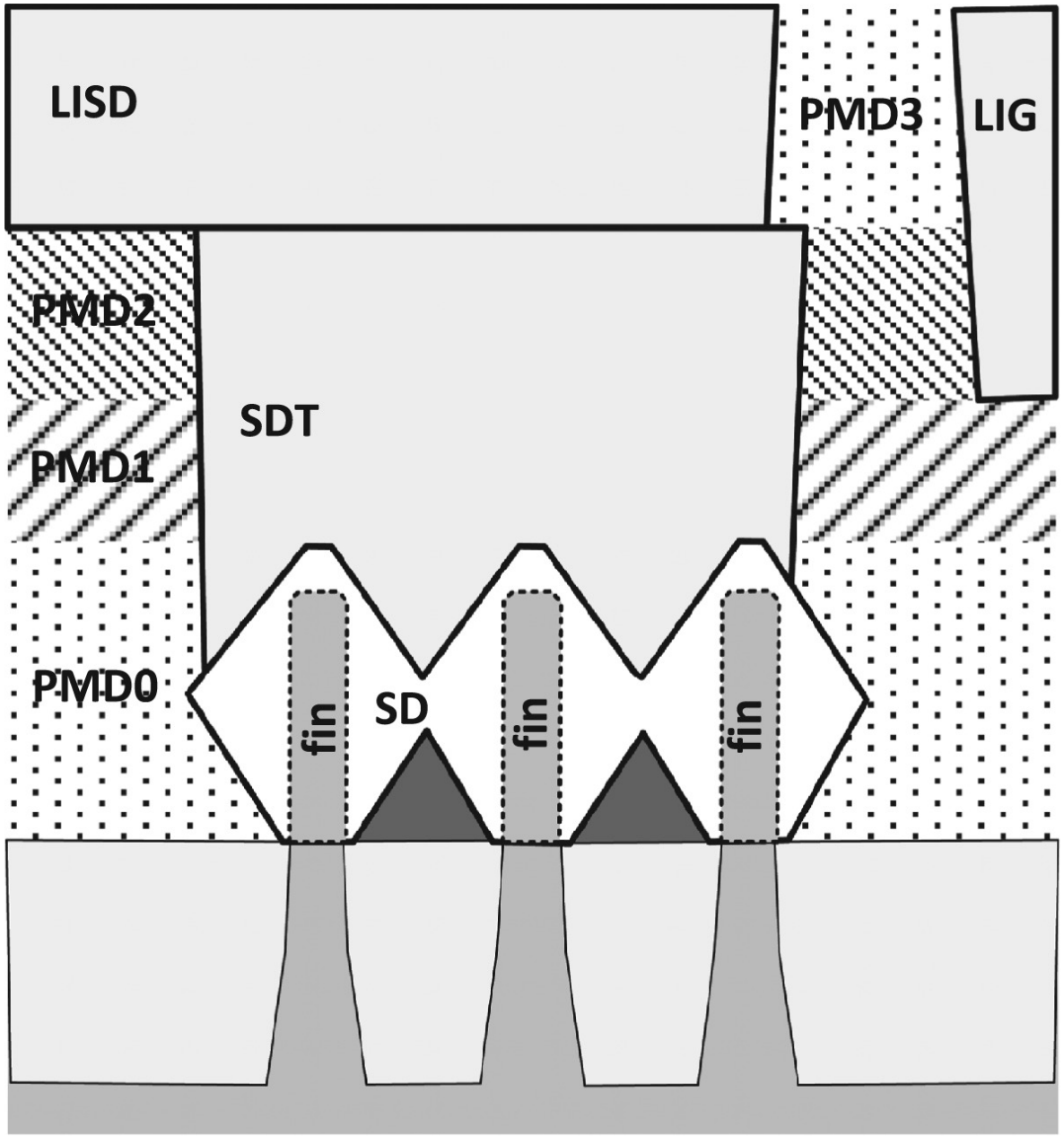
L7

Fin in ASAP7

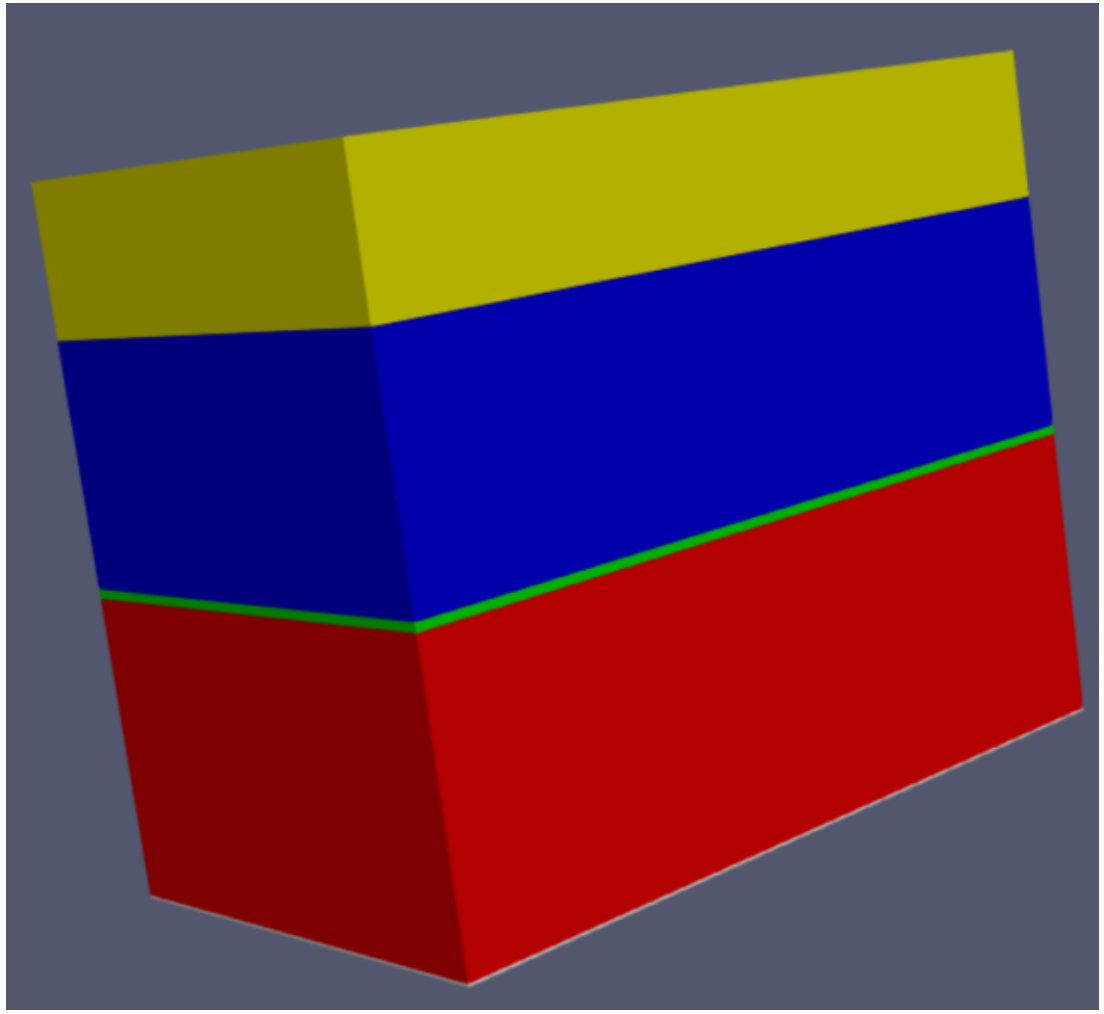
- Fin height = 32 nm. Fin width = 7 nm. (It's 6.5 nm actually, but we will just use 7 nm.)
  - A 32-nm-tall fin is a little short. (In reality, ~50 nm?)
  - STI depth = 30 nm
- It seems that ASAP7 does not improve the fin shape.
  - Anyway, just follow it.



Fin/SD cross section (ASAP7 PDK)

Pad oxide & hard mask

- A 100-nm-thick substrate
- Pad oxide = 3 nm
  - Actually, it is not deposited.
  - Thermal oxidation
- Hard mask = 80 nm
  - Silicon nitride
- Mandrel = 50 nm
  - Amorphous silicon



We want to have a fin pitch of 27 nm.

- Self-aligned quadruple patterning (SAQP)
  - In reality, it is used.
- For simplicity, self-aligned double patterning (SADP)
  - Draw lines with a pitch of 54 nm (= width of 24 nm + spacing of 34 nm).
  - Define a mask.
  - Multiple rectangles
  - `x0`, `y0`, `x1`, and `y1`

  (Two diagonal vertices)
  - These rectangles are masked.

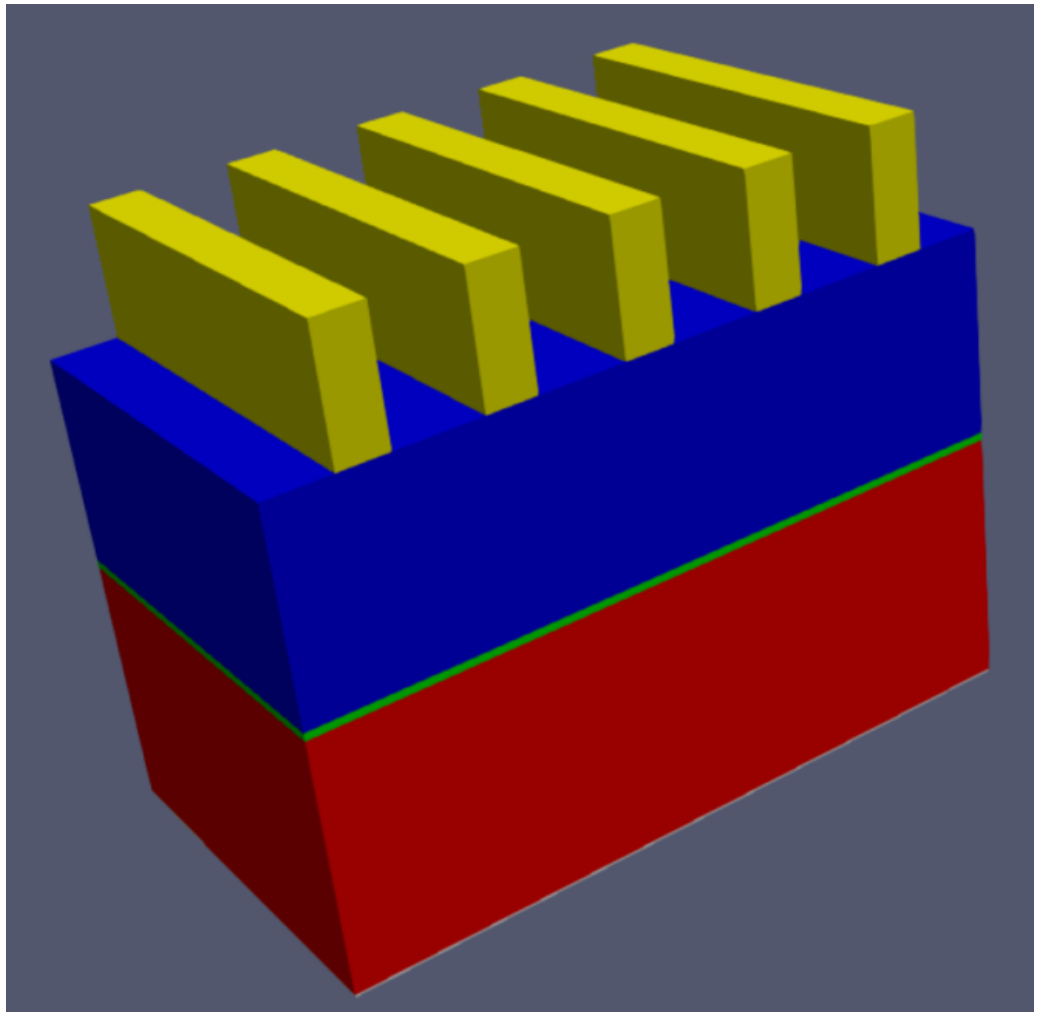
```
mask (name="mask_fin",lx=162,ly=288) {
    rectangle (x0=0,y0= 26,x1=162,y1= 46)
    rectangle (x0=0,y0= 80,x1=162,y1=100)
    rectangle (x0=0,y0=134,x1=162,y1=154)
    rectangle (x0=0,y0=188,x1=162,y1=208)
    rectangle (x0=0,y0=242,x1=162,y1=262)
}
```

Line pitch of 54 nm

- Etch using the mask.

```
etch (mask="mask_fin",thickness=50)
```

  - Anisotropic etching
    (Still under development!)

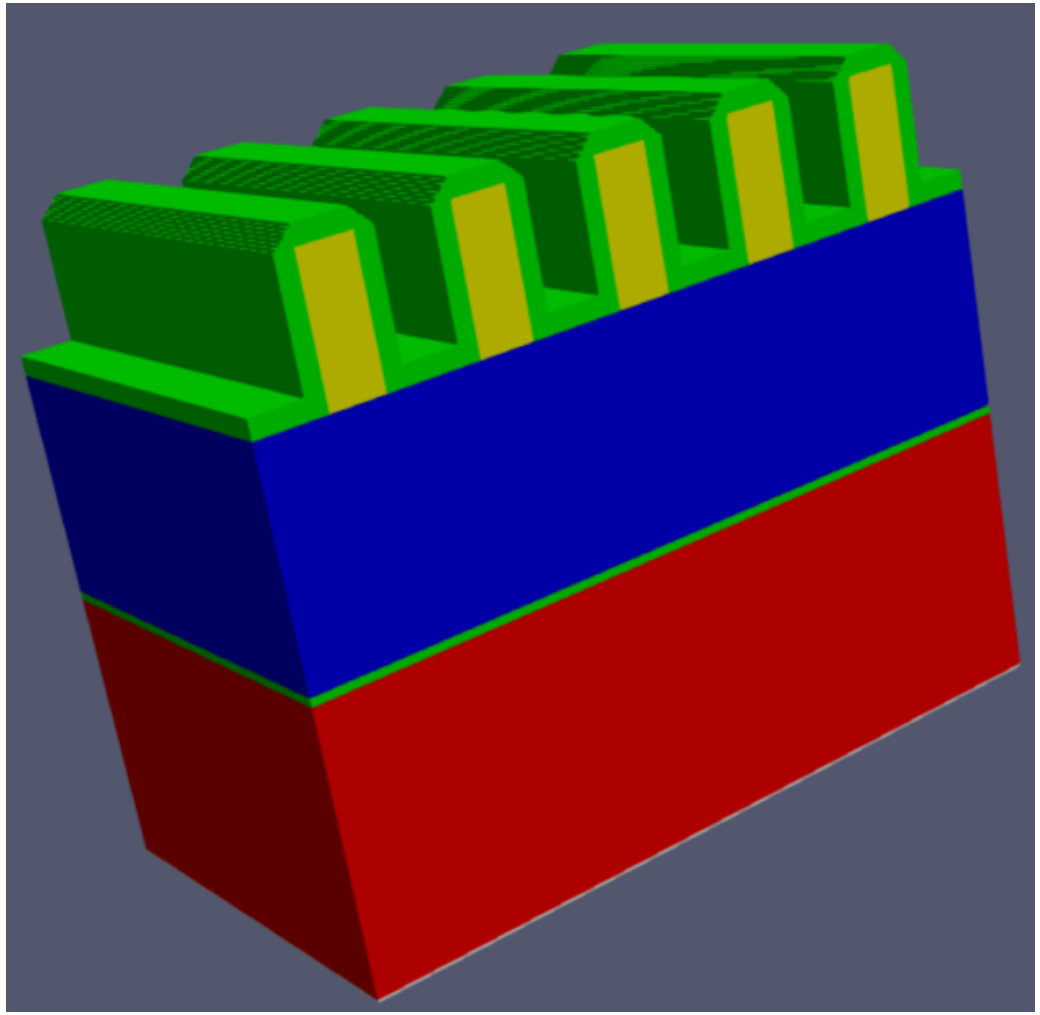


Isotropic deposition

- 7-nm-thick SiO_2

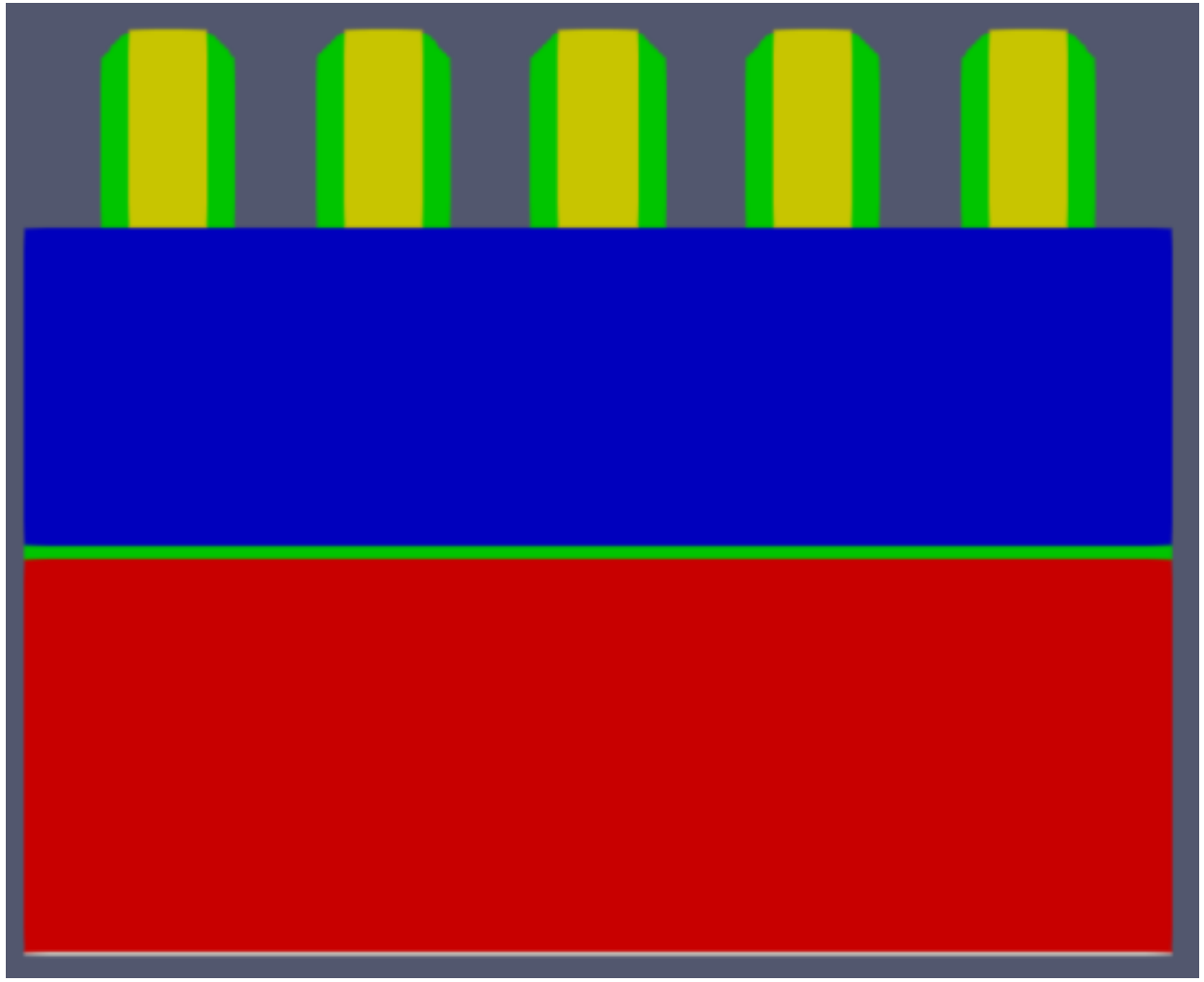
```
depo (region="SiO2",thickness=7)
```

  - (Its shape is not perfect.)



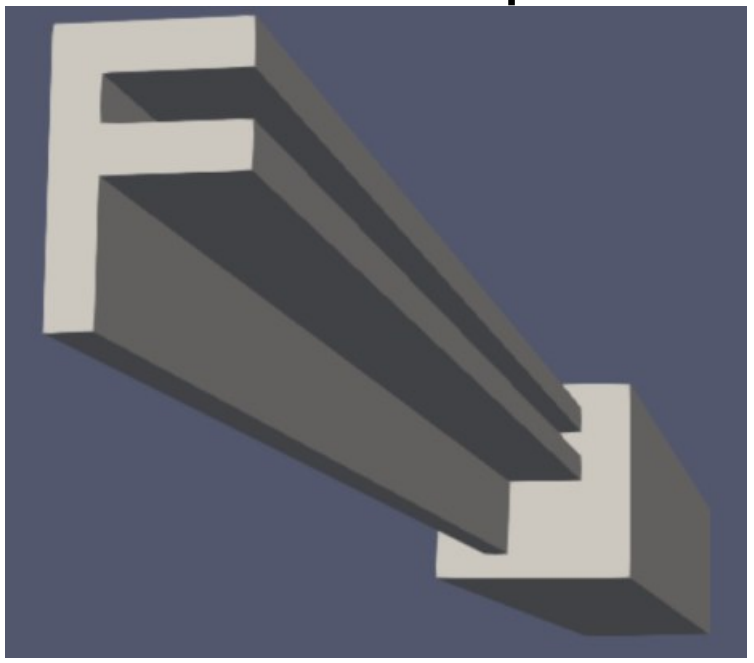
Anisotropic etching, again

- 7 nm, `etch (thickness=7)`
  - Remaining sidewall
  - Its thickness? 7 nm.
- Etching only a-Si
  - We have the fin pattern.



Homework#7

- Due: 08:00 on Sep. 29
- Submit a report through the GIST LMS system.
  - By using the AngstromCraft code, draw an alphabet letter, whichever you prefer.
  - Your report must show the final structure and the input file.
  - (The figure shows my F.)



Thank you!