

Special Topics on Basic EECS I Design Technology Co-Optimization

Lecture 15

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L11

How to load a CGNS file

- Assume that you have `inverter_fin.cgns`.
 - As the name suggests, it contains the structure after fin formation.
 - Now, you want to draw dummy gates and save the structure with a name of `inverter_dummygate.cgns`.
 - This is the way to load that CGNS file:

```
craft (name="craft",lx=162,ly=288,lz=400,region="DeepSubstrate",thickness=1,cgns="inverter_dummygate.cgns") {  
  load (cgns="inverter_fin.cgns")
```

File to be loaded

Match them File
to be loaded

Filename at the
end of dummy
gate formation

One important change

- Declare a region, before you use it.
 - When you want to grow a region,
 - If it is not called, your `model` statement cannot recognize it.

```
        region (name="SiGe")  
  
model (name="model_sd_SiGe") {  
    select (region="Silicon")  
    select (region="SiGe")  
}
```

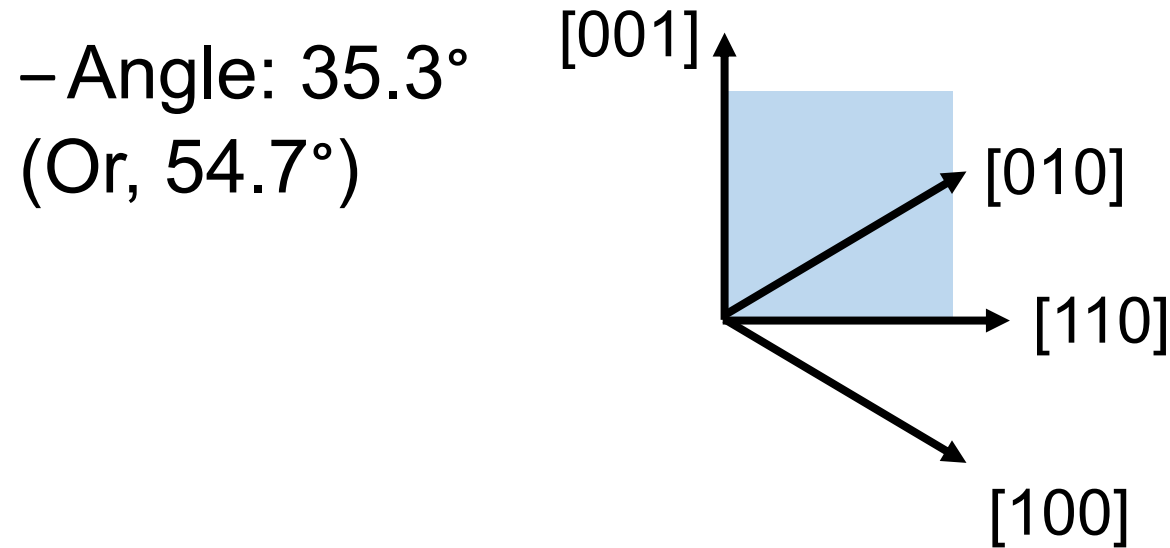
(001) wafer, [110] channel direction

- Silicon crystal structure

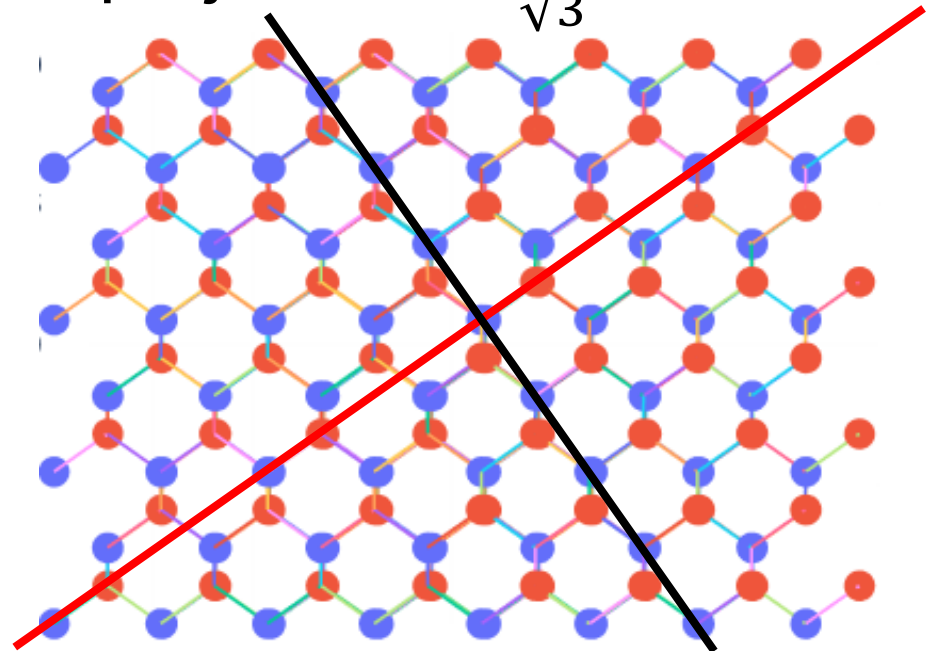
- [111]-directional unit vector: $\frac{1}{\sqrt{3}} \mathbf{a}_x + \frac{1}{\sqrt{3}} \mathbf{a}_y + \frac{1}{\sqrt{3}} \mathbf{a}_z$

- [110]-directional unit vector: $\frac{1}{\sqrt{2}} \mathbf{a}_x + \frac{1}{\sqrt{2}} \mathbf{a}_y \rightarrow$ Its projection is $\frac{\sqrt{2}}{\sqrt{3}}$.

- [001]-directional unit vector: $\mathbf{a}_z \rightarrow$ Its projection is $\frac{1}{\sqrt{3}}$.

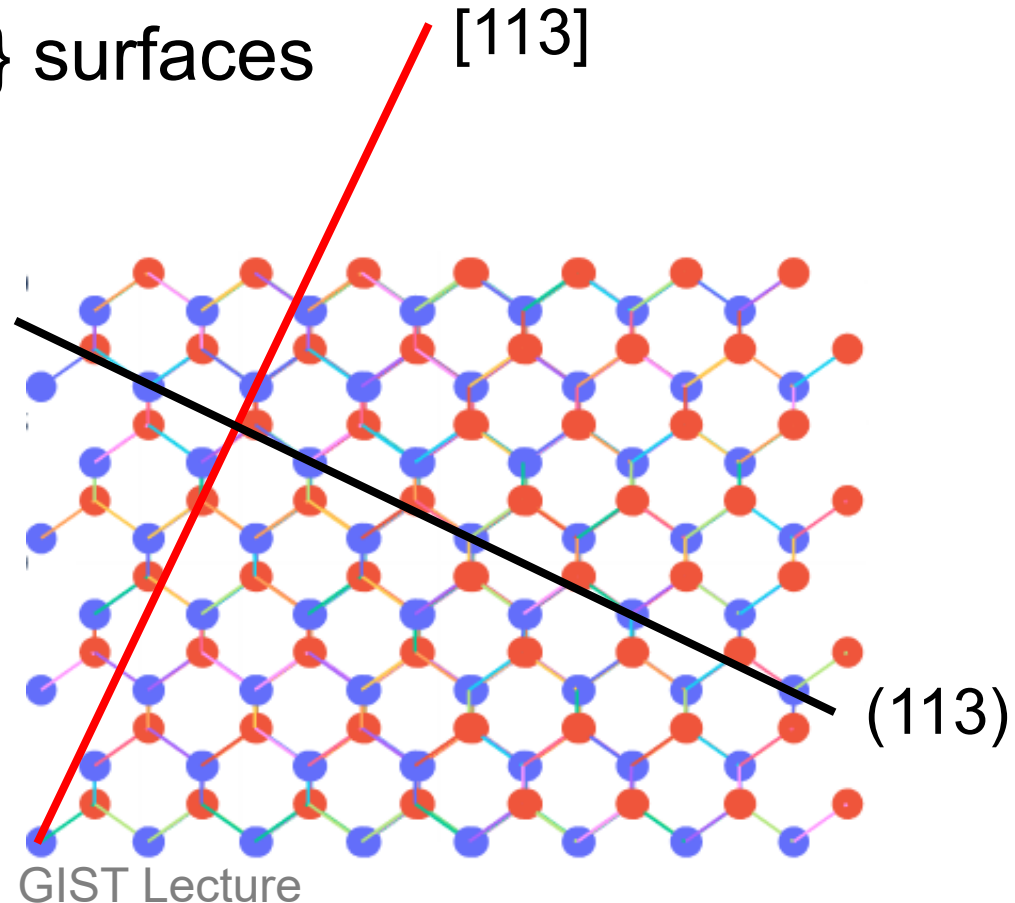
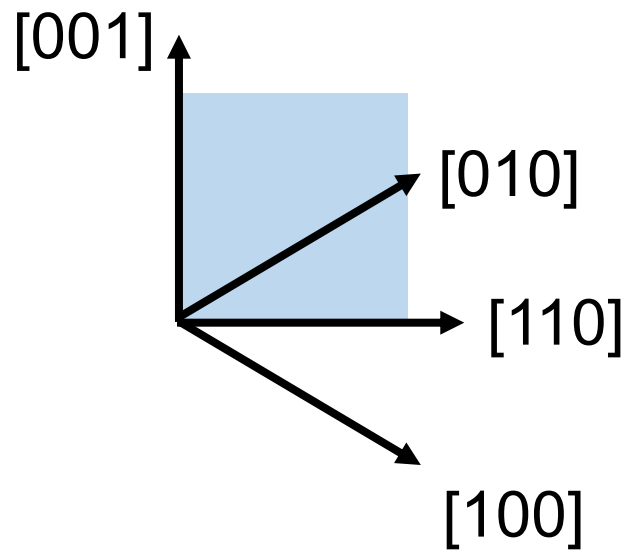


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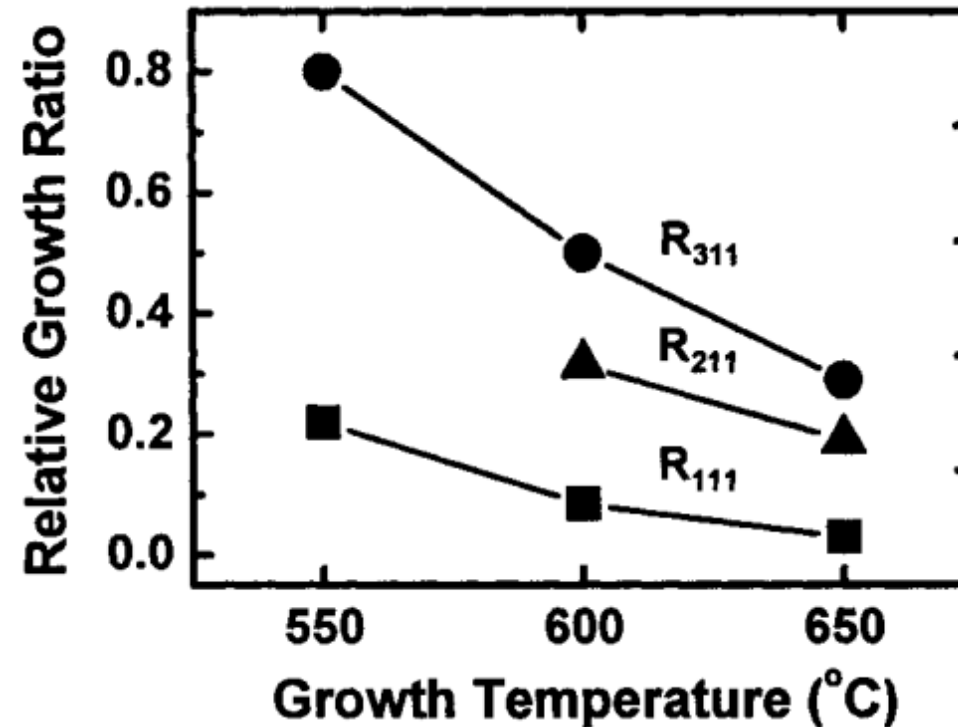
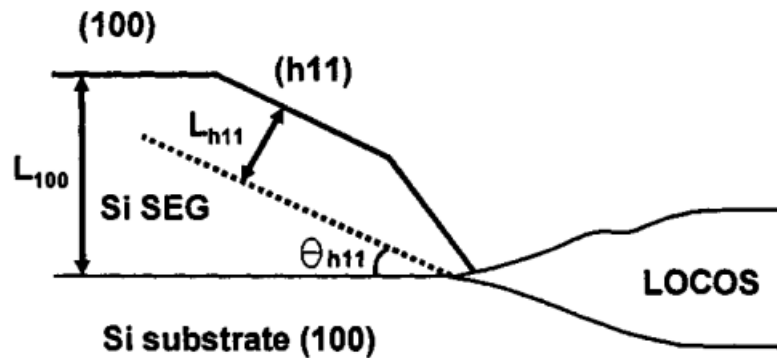
(113) surface

- {311} surfaces are usually found at the initial phase.
 - Angle: 64.7° (Or, 25.3°)
 - Later, dominated by {111} surfaces



Relative growth ratio

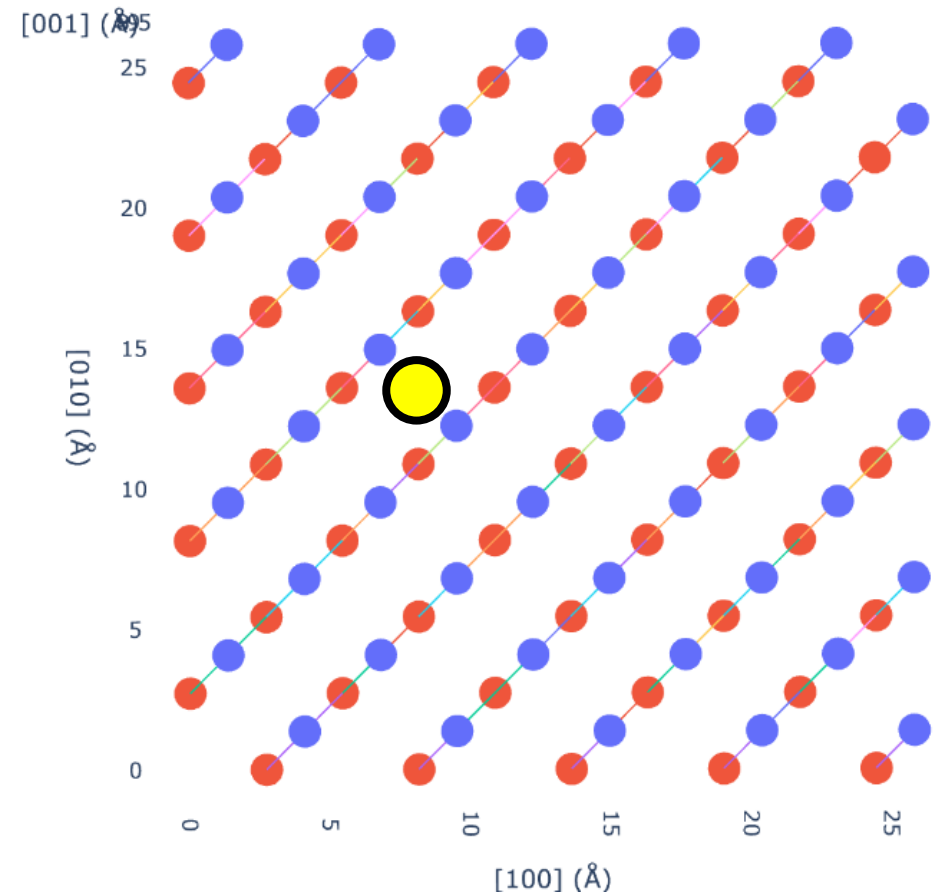
- It is found that the $\{111\}$ surface growth is the slowest.
 - Anisotropic growth rate



Relative growth ratio of (h11) facets with growth temperature (S.-H. Lim et al., SNU)

(001) wafer surface

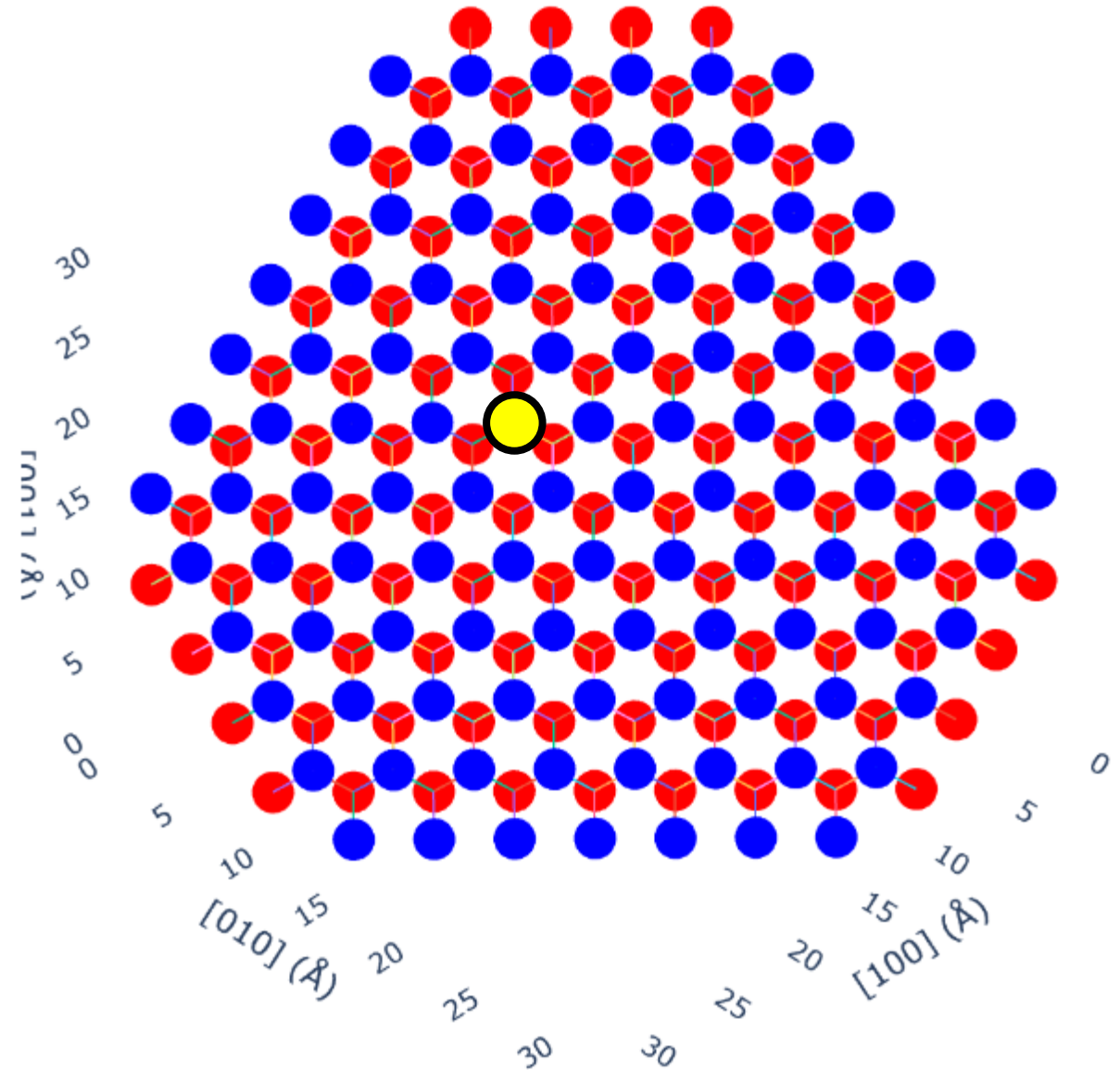
- The top layer (blue) and the second layer (red)
 - Add one additional atom. (yellow)
 - There are two NN atoms.
 - There are four second NN atoms.



(111) wafer surface

- The top layer (blue) and the second layer (red)
 - Add one additional atom. (yellow)
 - There is only one NN atom.
 - There are three second NN atoms.

(In reality, the actual growth seems to be more complicated...)



Homework#11

- Due: 08:00 on Oct. 20
- Submit a report through the GIST LMS system.
 - By using the load capability, follow L10 lecture material, again.
(Whenever you need a `model` statement, first declare a `region`.)

Thank you!