

6.1.4 Summary to: 6.1 Materials and Processes for Silicon Technology

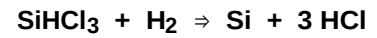
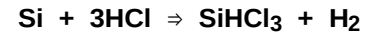
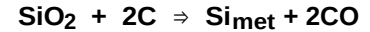
Making "metallurgical" (= "dirty") **Si_{met}** is easy: ⇒

- A large scale **Si_{met}** production (> **1 Mio tons/a**) exists for metallurgical ("alloying") and chemical ("silicones") uses

A small amount of **Si_{met}** (some **20.000 to/a**) is purified (factor **10⁹** or so) to "semiconductor grade **Si**" ⇒

- Produce high-purity trichlorosilane (**SiHCl₃**) gas in a reactor and distill.
- Use **SiHCl₃** and **H₂** to deposit **Si** on some **Si** core by a **CVD** process

The final result is ultra-high purity (and expensive) **poly Si** (already doped if so desired)

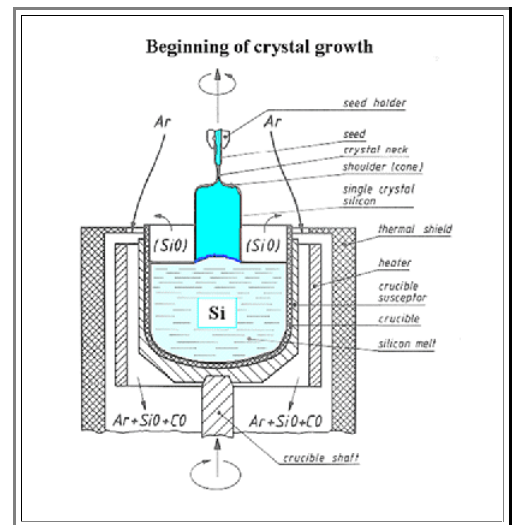


Growing a "perfect" single crystal from this **poly-Si** is not easy - but possible.

- The major crystal growth method is the **CZ** (= Czochalski) method: "Pull" the crystal from a crucible full of molten **Si**. ⇒
- Some (usually < **300 mm** diameter) crystals are grown by the **FZ** (= float zone) method. Somewhat better perfection, but more expensive than **CZ**.

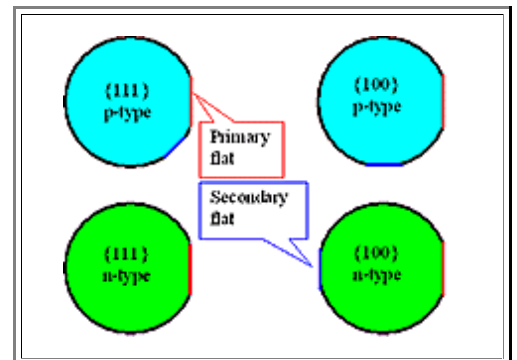
Major problem: Impurity segregation = general tendency for most impurities (including doping atoms) to remain (= enrich) in the melt.

- Segregation coefficient = $c_{\text{cryst}}/c_{\text{melt}}$ at interface, often $\ll 1$ and dependent on parameters like growth speed (usually a few **mm/min**).
- + Crystal is purer than melt.
 - It is practically impossible to grow a crystal with a uniform impurity (including dopant!) concentration along its length.



Produce wafers by cutting, grinding and polishing

- Extreme precision for a mass product is needed.
- "Flats" or "notches" (for wafers > **200 mm**) identify the crystallographic orientation and the doping type.
- Beware! Flats are often customer specific and different from the norm. ⇒



Questionnaire

Multiple Choice questions to all of 6.1