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*Books to be preffered:

→ James plumer

→ SMG – phy. & tech of SCD.

Introduction to VLSI Technology

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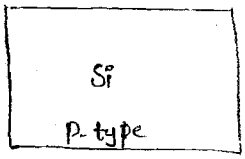
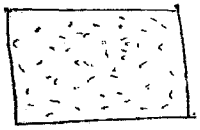


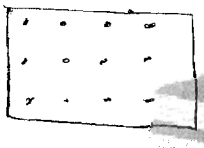
To get this, silicon wafer

SiO_2 —react with any Carbon material→ (Si) mG —HCl→ $SiHCl_3$ —Distillate→ Pure $SiHCl_3$ (B.P @ 32°C) —H_2→ highly pure form of Si. (Si) electronic grade.

To make Si-wafer it should be: 1.5 – 2 mm.

According to crystailinity :- 1) Amorphous – Atoms are Irregular
2) Crystalline – Atoms are regularly arranged
3) Poly crystalline – b/n amorphous & crystalline.


1)


2)


3) Grain [regular].

* atoms in grain are regularly arranged
* But all grains are not regularly arranged

* After process we got Si cannot be in "Crystalline" form, only in either "Amorphous | poly Si- form."

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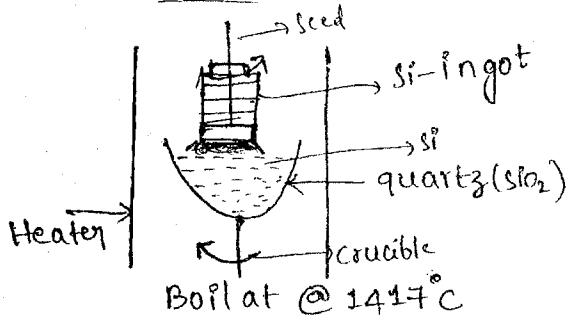
1. CZ-Process :- (Czochralski) :-

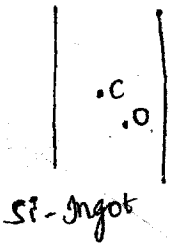


⇒ 3mm/hr – Typical pull rate of crucible & seed.

→ By moving, liq. Si get attached to Seed & becomes as Solid-Si.

→ Solid-Si is ingreted into "ingot."

Heater → made of Carbon
quartz → SiO_2



Slice & ⇒ polish ——↕ 1.5-2mm

* Si obtained may contain 'C' & 'O'

⇒ 90 % applctns – this process made Si-wafers are used.

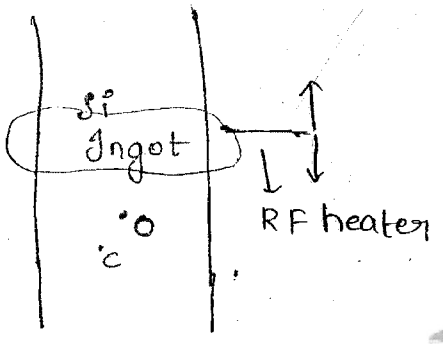
* Even though Si(1mm) we use only surface which is "few nm's" &
* So, C & O even though present on Si-wafer, it won't effect

* Gattering:- The process of heating of si-wafer at very high temp. (hydrient temp), so that C & O will diffuse to bottom & it becomes pure on top is known as gattering.

* To form even pure Si - we go for FZ process

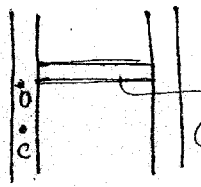
* FZ - process (Float zone):-

* Starting material is Ingot (Si) prepared from CZ-process.



→ RF heater softens the Si at particular area only.

→ Move RF heater up & down to make soften Si at some areas.



→ O & C deposit at walls only.

→ liquid strip float all along the Ingot.

→ Cut the material into wafers.

→ This is known as "FZ - wafer"

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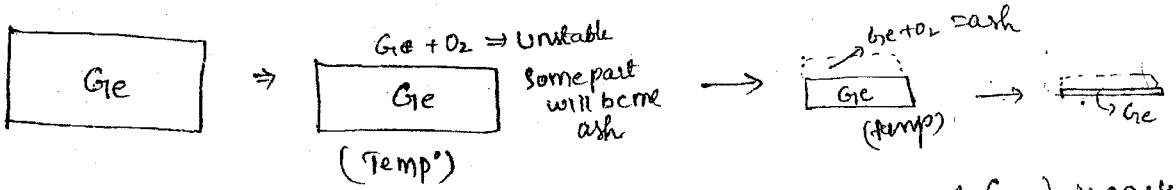
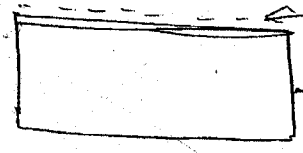
* SiO_2 is very stable than Ge-oxide.

* Energy required to break Si-O_2 bonds > E req. to brk Ge-O_2

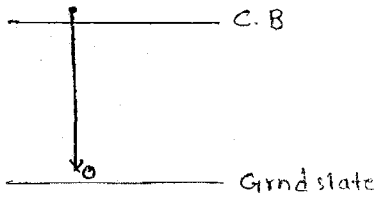


* Ge should be protected as it expopes to air(O_2) → reacts & becms ash at ambient temp.

* low Bandgap hence low leakage current

* 

→ RCA clean (Treating Si wafer with Hcl & H_2SO_4, such that Si-wafer is free from metallic & organic impurities.



* e's in higher energy state falls to grnd state to recombine is known as recombi-nation.

* Si + metallic impurities ⟶ ↑recombntn. rate → life time ↓ → μ ↓

*RCA clean:-

Si-wafer ⟶ DI water cleaning

↓

SC1 { HF Dip. → Treat with HCl (a thin layer of SiO_2 is formed) → HF-Dip.

SC2 { DI-water clean → Treat with H_2SO_4 (Thin layer of SiO_2 is formed) → HF Dip.

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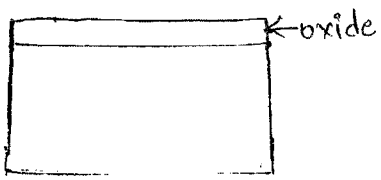
* Now obtained is pure form of Si.

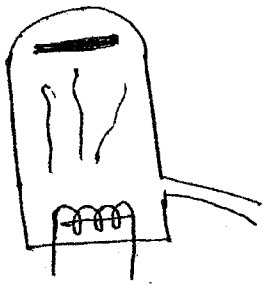
* Si- is a dopant in GaAs

III	IV	V
Ga	Si	As

* If Si- take site of Ga → n-type
Si - " " As → p-type.

* Equipmnt used by Cmpnd S.c's → can be used by 'Si'
But not Vice-Versa.





Evsp

PVD - Physical Vapour deposition

Sputtering