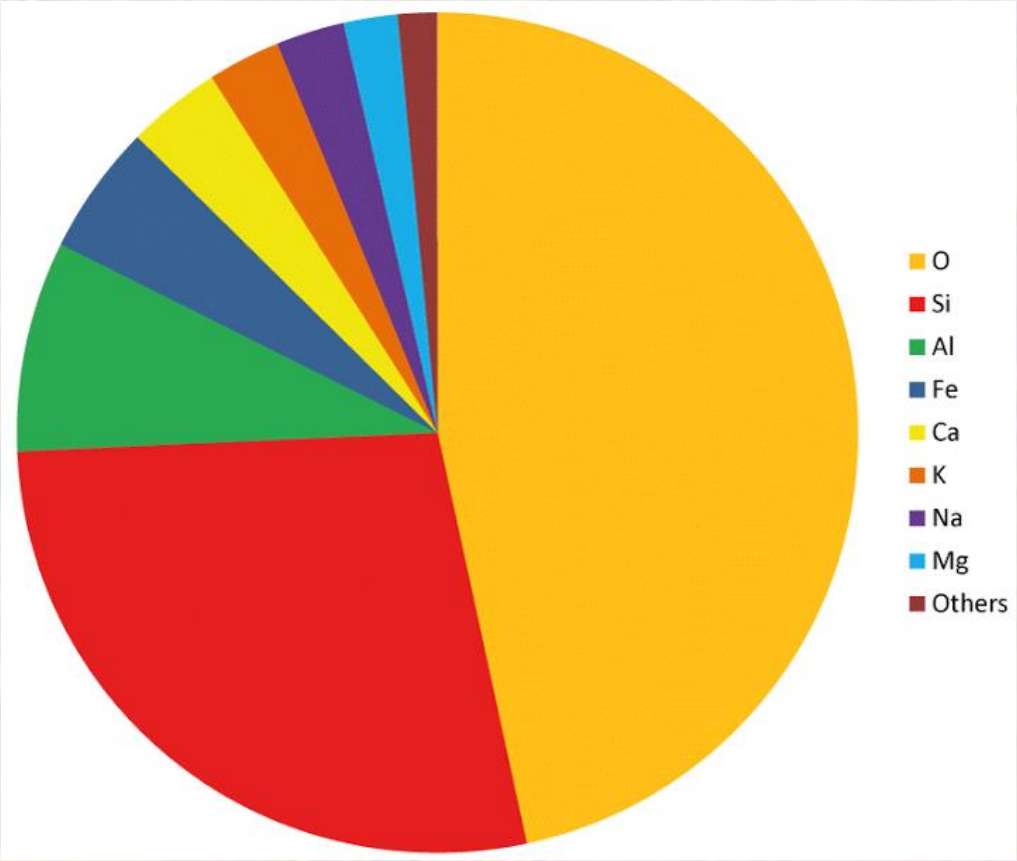
Wafer Creation

Last updated 2/19/19

Wafer Creation

- Semiconductor Grade Silicon
  - 28% of the earths crust by weight is Silicon
  - 47% of the earths crust by weight is Oxygen



src: www.sandatlas.org

Wafer Creation

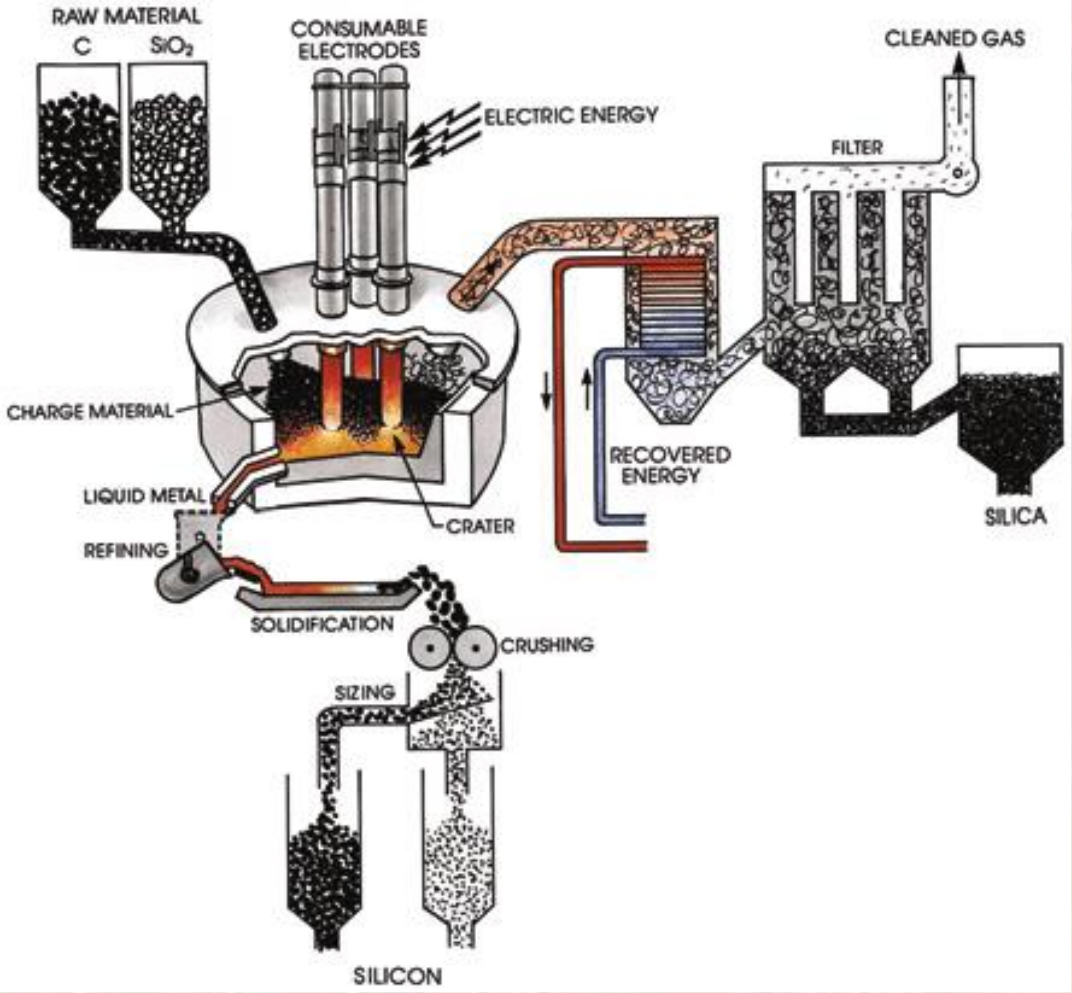
- Semiconductor Grade Silicon
  - Silicon is highly reactive
    - Combines with almost anything
    - Especially Oxygen
  - Pure silicon is very rare
  - $Si0_2$ is very common (quartz)
  - Silicon can be extracted by reaction with Carbon

$$SiO_2 + 2C \leftrightarrow Si + 2CO$$

  - This is a relatively dirty reaction so additional purification is required

Wafer Creation

- Semiconductor Grade Silicon



src: www.researchgate.net

Wafer Creation

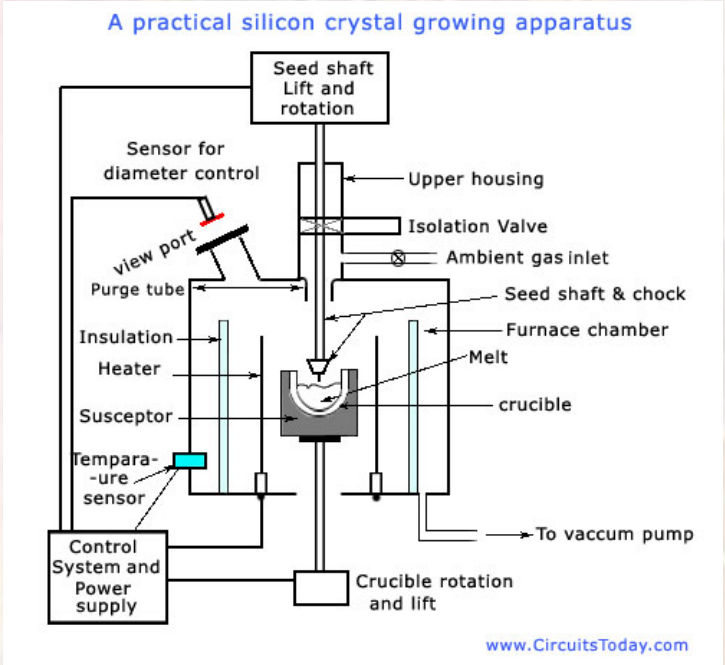
- Semiconductor Grade Silicon
  - Si purification is done in a 4 step process
    - $Si + 3HCl \leftrightarrow SiHCL_3 + H_2$ Triclorosilane
    - $SiHCL_3$ is distilled (boils off at 31.8°C)
      - Very pure at this point
    - $SiHCL_3 + H_2 \leftrightarrow Si + 3HCl$ reverse of step 1
    - Si is deposited as a solid through Chemical Vapor Deposition
  - Result is pieces of ultra pure polycrystalline Si

Wafer Creation

- Semiconductor Grade Silicon
  - Bulk doping is done by replacing some of the H_2 with
    - N-type: PH_3
    - P-Type: BH_2

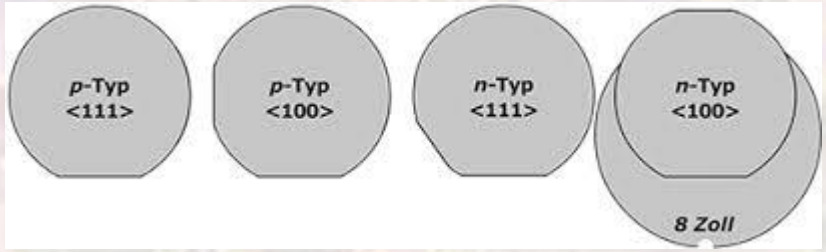
Wafer Creation

- Silicon Ingot formation
  - Ultra-pure polysilicon is melted in a crucible
  - A small piece of crystalline silicon (seed) is lowered into the crucible
  - As the seed is slowly pulled out of the crucible, some of the melted silicon aligns with the seed and crystalizes as it cools
  - The seed is rotated as it is pulled up causing a cylinder of crystalline silicon to form



Wafer Creation

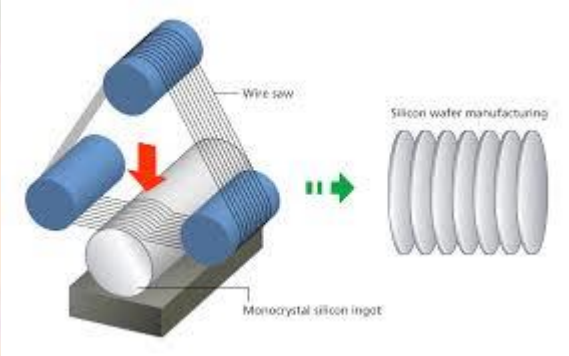
- Silicon Ingot formation
  - Once the ingot is complete it is ground to a fixed – smooth diameter
  - One edge of the ingot is ground flat to indicate the crystal orientation



src: microchemical.com

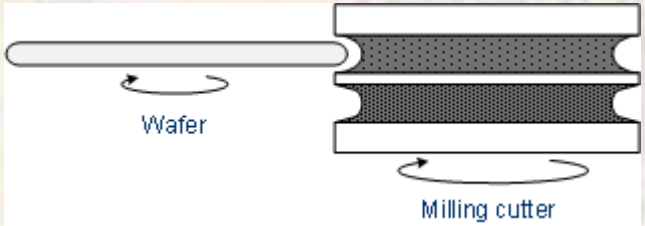
Wafer Creation

- Silicon Wafer formation
  - The Si ingot is sliced into wafers



src: Nikon.com

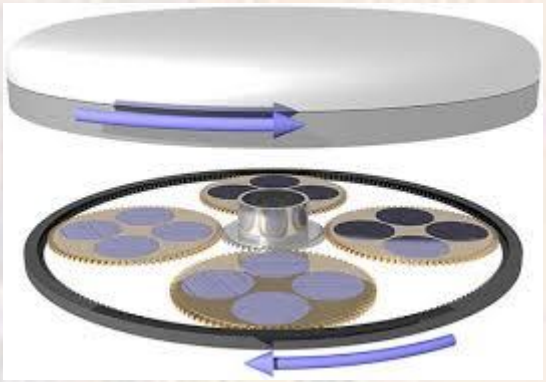
  - The edges are rounded over



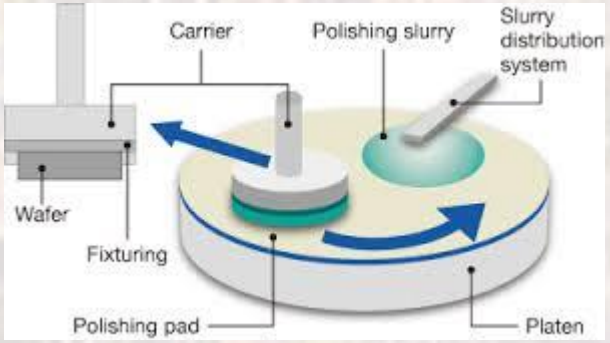
src: Halblieter.org

Wafer Creation

- Silicon Wafer formation
  - The wafers are lapped (smoothed), etched (cleaned) and polished



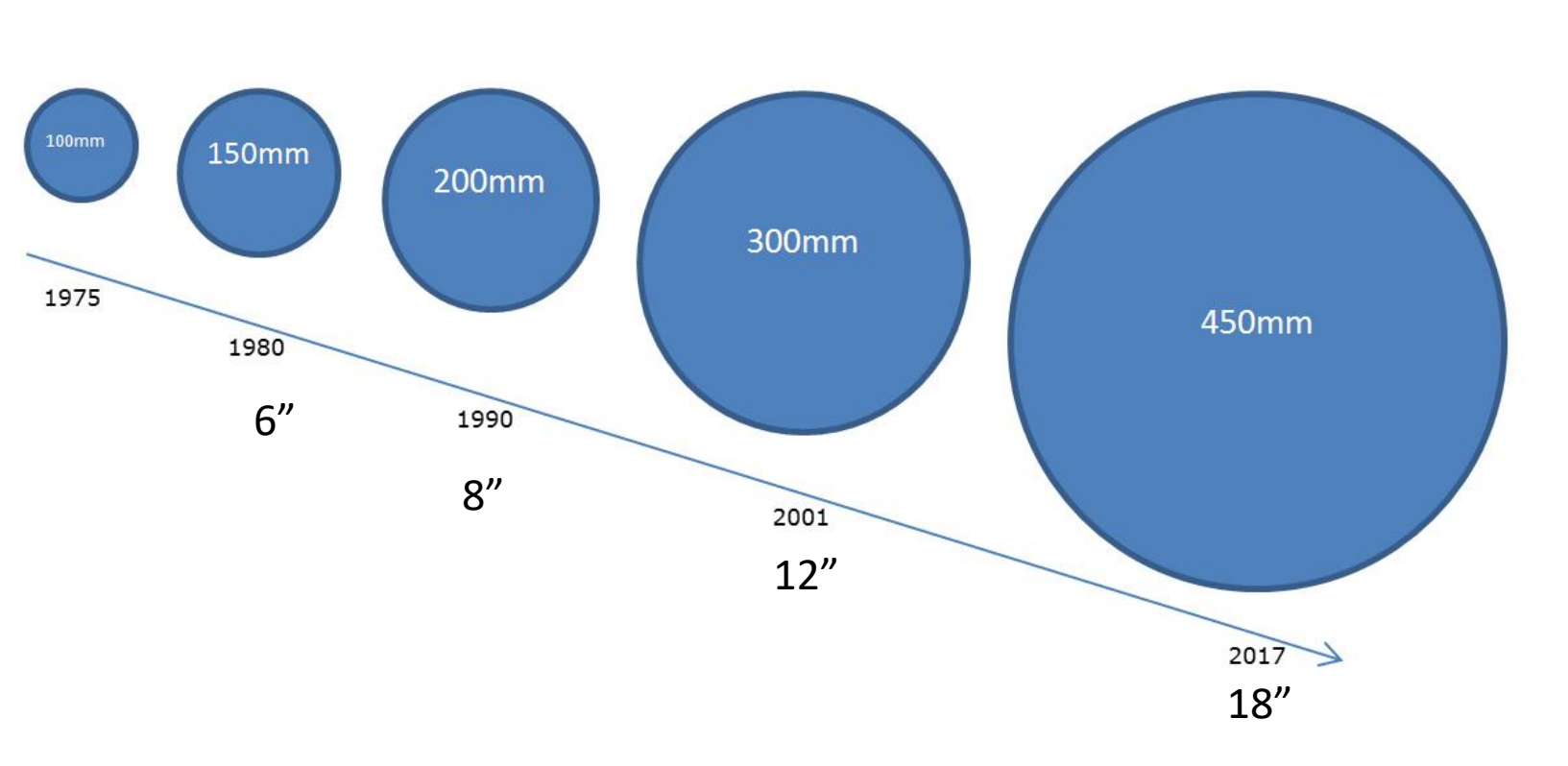
src: microchemicals.com



src: nittahaas.com

Wafer Creation

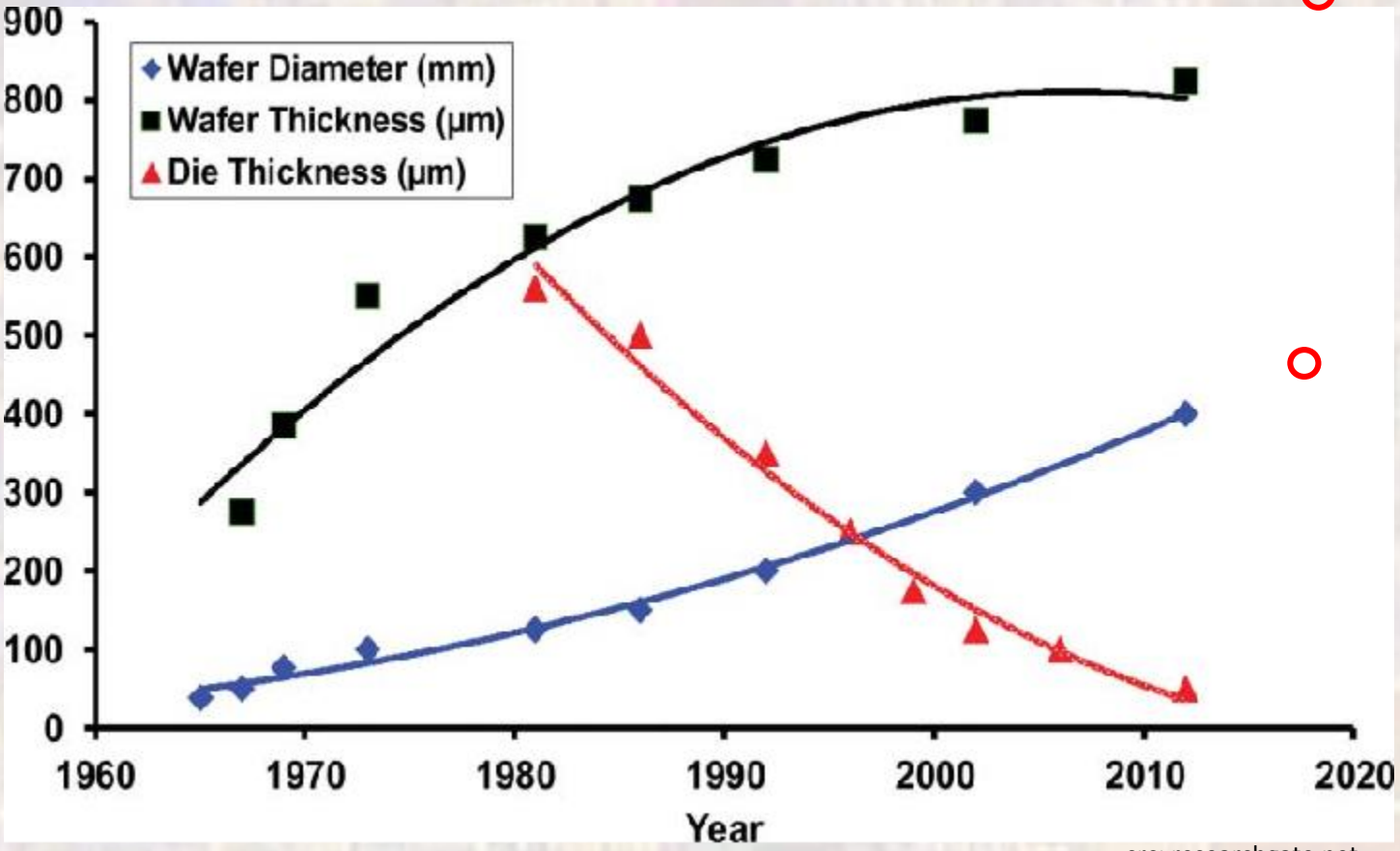
- Silicon Wafer formation
  - Wafer diameters



src: anysilicon.com

Wafer Creation

- Silicon Wafer formation
  - Wafer thickness



src: researchgate.net

Wafer Creation

- Video

https://www.youtube.com/watch?v=AMgQ1-HdElM

src: micro chemicals