Silicon processing

Metallurgical grade silicon

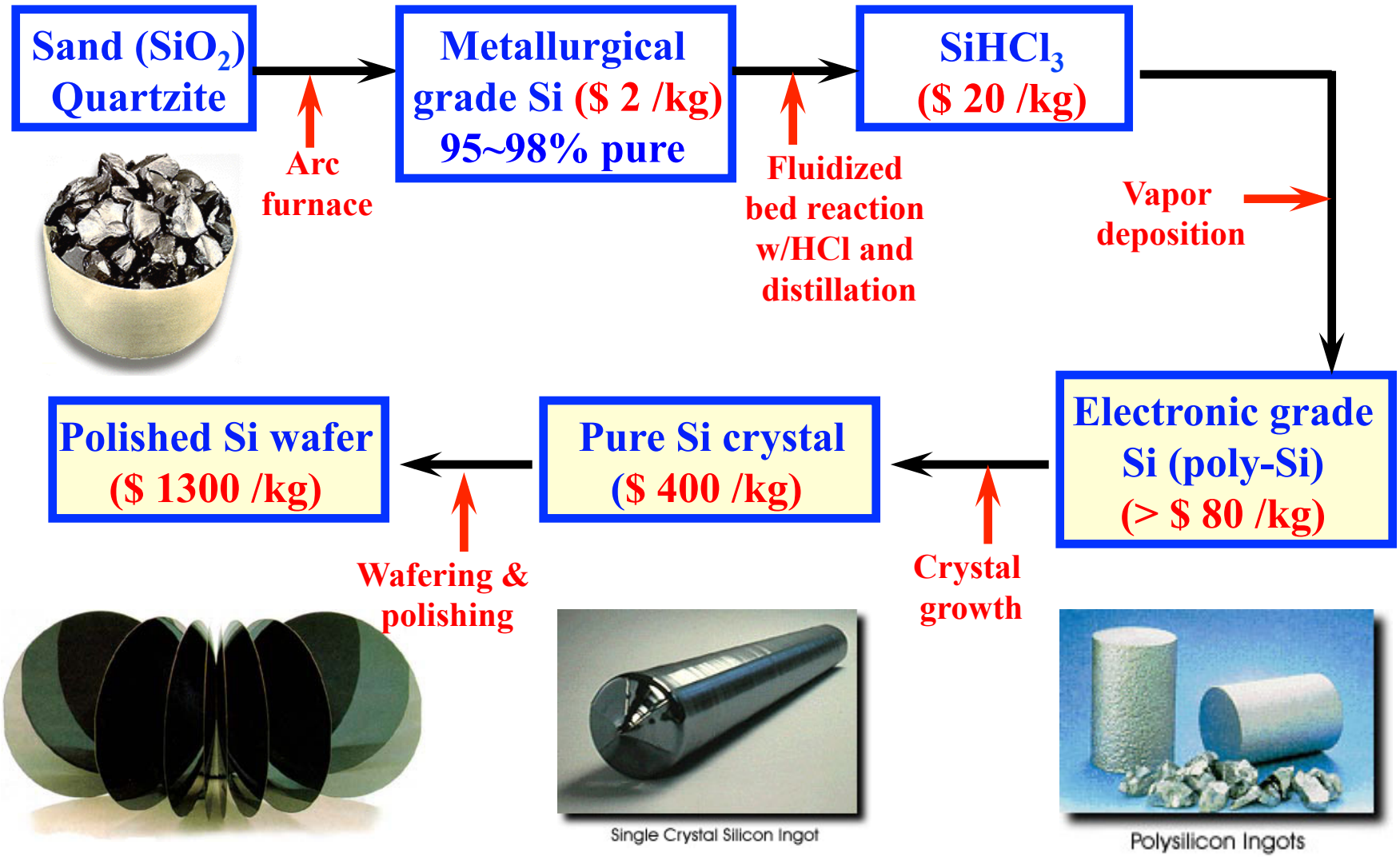
(Solar grade silicon)

Electronic grade silicon

Wafers

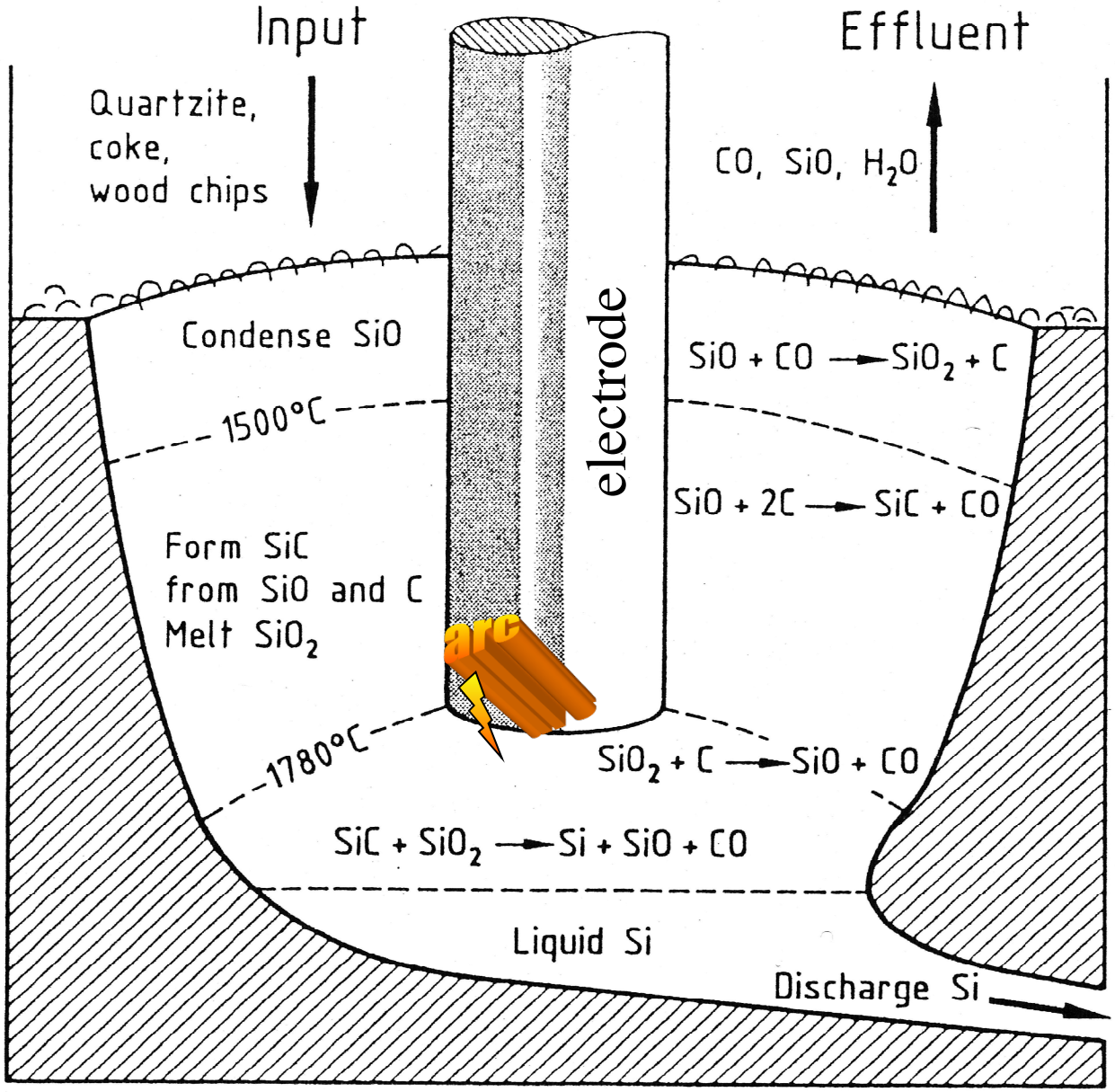
overview

Sand to silicon wafer



Source: http://www.fullman.com/semiconductors/semiconductors.html

Production of metallurgical grade Si



Overall reaction

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

Complicated in furnace

Charge porous or explosion

Elkem

A world leader Si supplier

To steel -, Al alloy industry

Purification of MG Si -> Semicond. grade

Through Chlorsilane

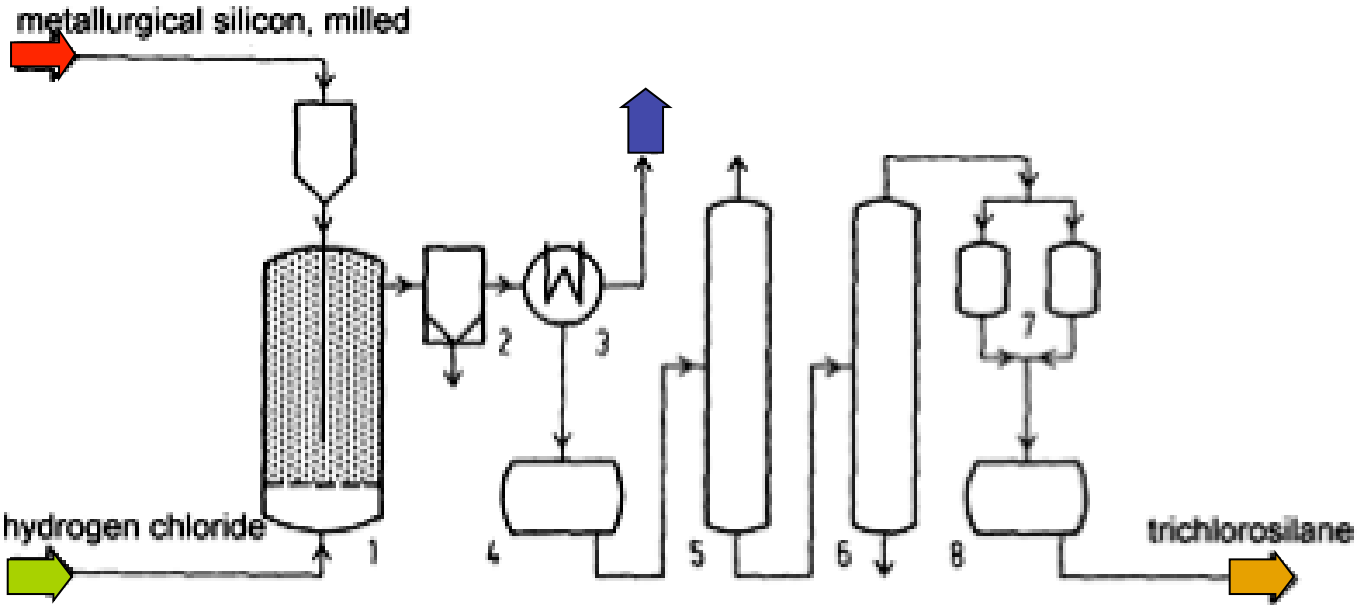


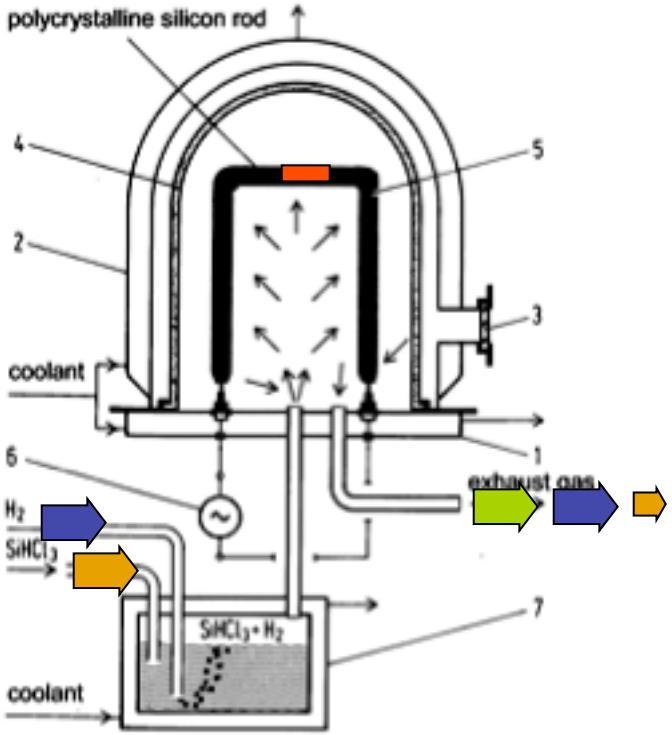
Fig. 3-1: Flow chart of a facility for production and purification of trichlorosilane. 1: fluidised bed reactor, 2: dust filter, 3: condenser, 4: collector, 5: column for cutoff of low boiling materials, 6: column for cutoff of high-boiling materials, 7: intermediate collectors, 8: storage tank

$$Si(s) + 3HCl(g) = SiHCl_3(g) + H_2(g)$$

Purification of MG Si -> Semicond. grade

Chlorsilane to polyX Si

CVD(Siemens)



1950 Fig.

Only bigger in modern

Fig. 3-2: Schematic drawing of a facility for silicon refinement from the gas phase (Siemens process). 1: cooled platform, 2: cooled protective glass, 3: viewing glass, 4: quartz bulb, 5: silicon core (thin rod), 8: current supply, 9: saturator

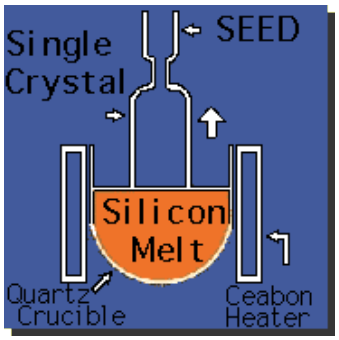
Today: Si 2-3 m length

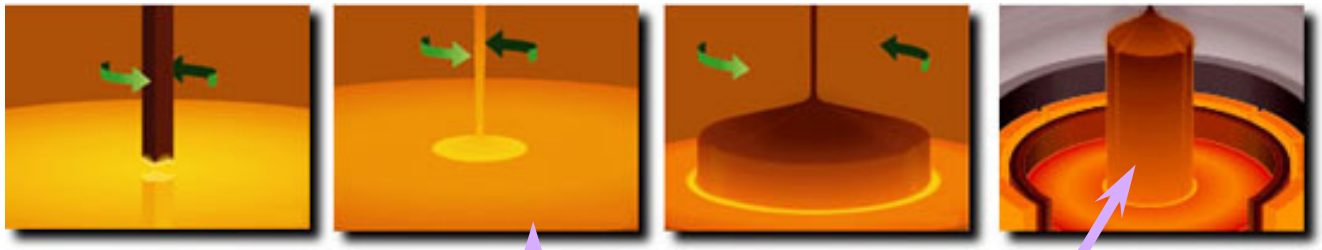
900 °C,

$Si(s) + 3HCl(g) = SiHCl_3(g) + H_2(g)$

Growth of Electronic grade Si (xtal) from Semicond. Grade poly xtal Si

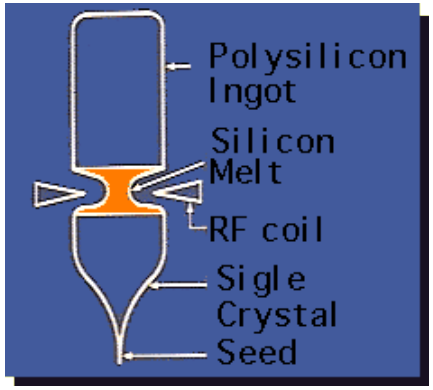
Czochralski (CZ) and float-zone (FZ) techniques

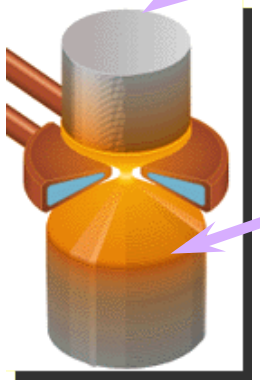




CZ

Poly-Si



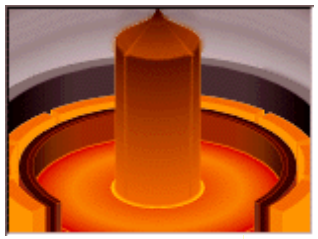


FZ

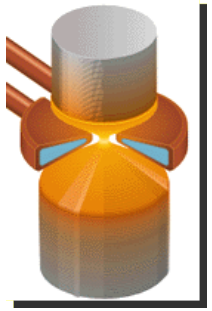
Single crystal Si

Sources: http://www.fullman.com/semiconductors/semiconductors.html
http://www.msil.ab.psiweb.com/english/msilhist0-e.html

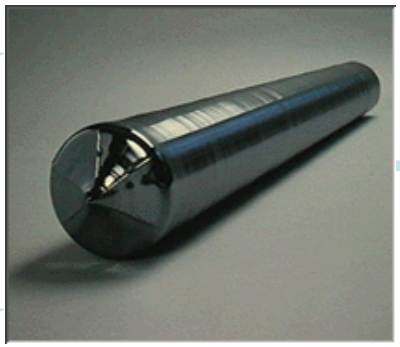
Ingot to wafer



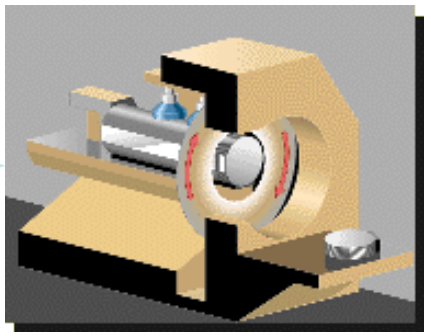
CZ



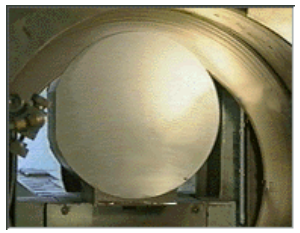
FZ



Ingot

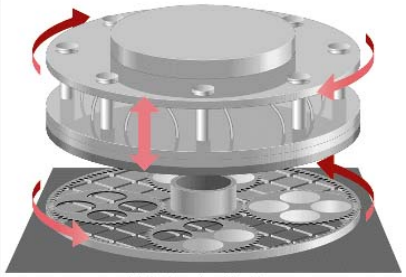


Slicing



Wafer Polishing
(Strasbaugh Corporation)

Polishing



Wafer Lapping Machine
(Mitsubishi Materials Silicon)

Lapping

Wafers for IC manufacturing

Sources: http://www.fullman.com/semiconductors/semiconductors.html
http://www.msil.ab.psiweb.com/english/msilhist0-e.html

increasing wafer size

2” dia. → 12” dia.

12” pizza