Overview of large silicon masses (current technology/future possibilities)

ET-LF wavelength workshop Sept. 3rd

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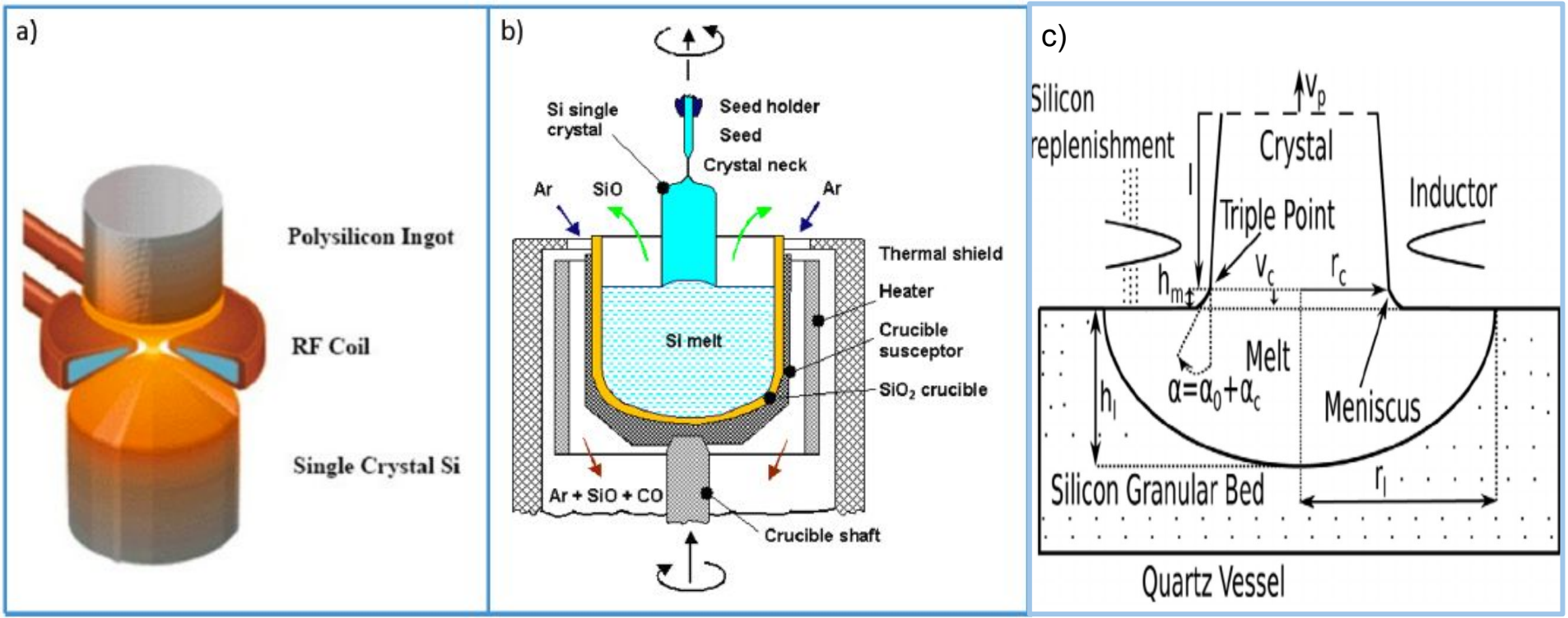
Challenge: Large diameter (>30cm) + Pure monocrystalline Si + Uniformity over full diameter

Crucible: Usually made of silica with a graphite heater->Oxygen and carbon impurities.



a)Float Zone. Crucible free b) Czochralski/Mag assisted Cz. Silica/graphite crucible c) SigC. Self crucible

Ref: https://zenodo.org/record/3820523 https://onlinelibrary.wiley.com/doi/epdf/10.1002/crat.202000044

Approach	Max. ingot diameter(mm) current/possible	Contamin-ants	silica crucible/graphite heater?	Uniform over full diameter?	Dislocation free?	Under development?
Standard Czochralski (Cz)	450/>450	Oxygen, carbon, trace metals	yes	No	yes	Well developed
Magnetic field Applied Czochralski (MGZ)	450/>450	oxygen/carbon (lower than Cz)	Yes (but B field helps)	Possible(?) still under development	yes	yes
Float Zone (FZ)	200/200	Highest quality Si to date	No	Yes	yes	Well developed
SigC/Silicon "self crucible"	100/450	Currently limited by available Si granules	No	Possible (still under development)	Possible (still under development)	yes
Directional Solidification	450/450	Between MGZ and Fz	No	No	No	no

Limits and Possibilities

- Float Zone produces best quality by far, but is diameter limited to ~20cm.
- Standard Cz: Too many impurities.
- MGZ: Still under development, possibility to produce better quality/more uniform masses. Combine with 650C anneal could lead to higher resistivity (Ashot M./Chris W.)
- SigC: Approach under development at IKZ, promising self-crucible approach to attain large/pure ingots.
- **Combination of approaches, composite masses should be considered.**

References/longer writeup here:
https://docs.google.com/document/d/1CSep2G7KU1DIJzcAZjPocqEIfbtFECBZU0EGk3PdiAs/edit?usp=sharing

Thank you for listening!