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20-Micron-Thick Si Solar Cells with 20% AM0 Efficiency

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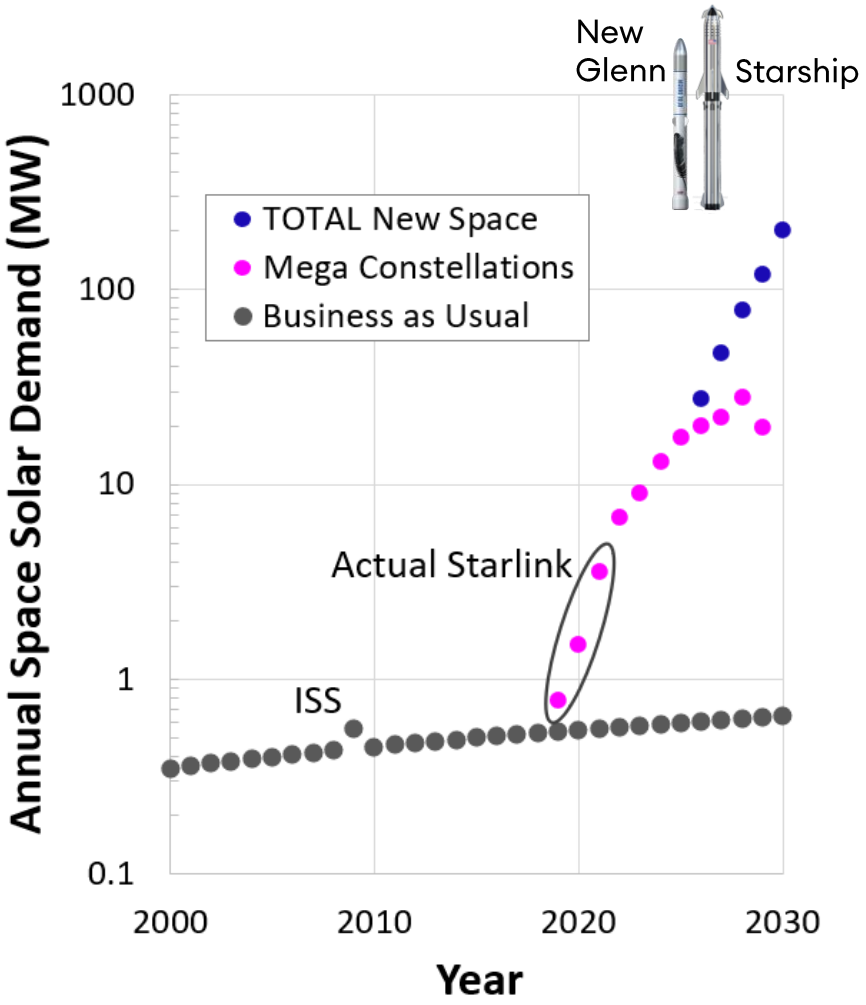
Motivation and Cell Structure

Why Silicon?

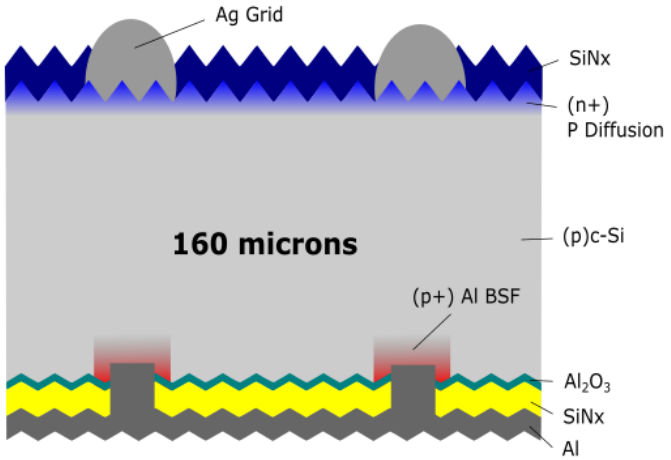


What Type of Silicon?

Commercial Cells

160-micron-thick
Diffused Junction
Screen printed Ag and Al

- **Degrades fast under radiation**
- **Rigid**



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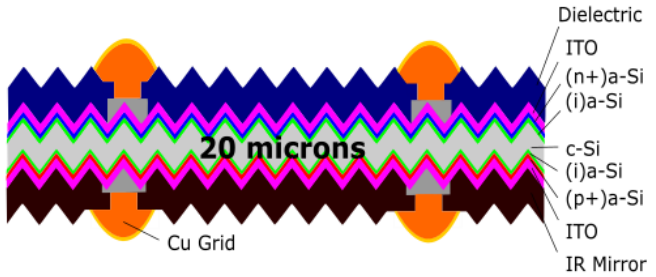
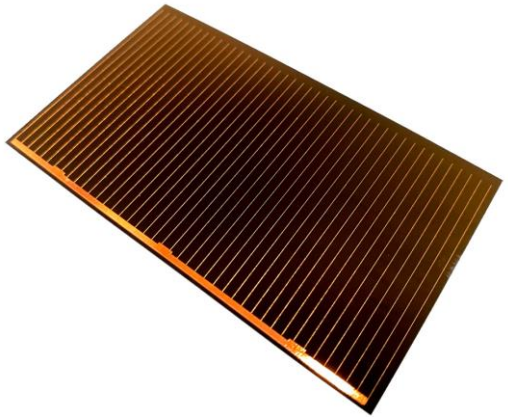
20-micron-thick
a-Si/c-Si Heterojunction
Electroplated Cu

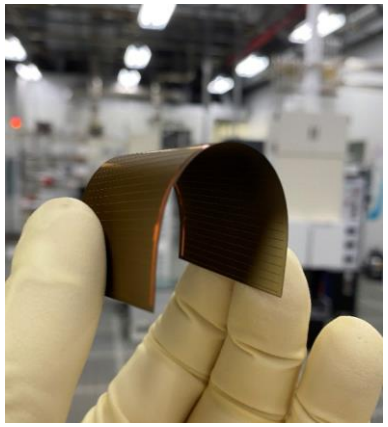
- **Potentially more radiation hard**
- **Light-weight and flexible**

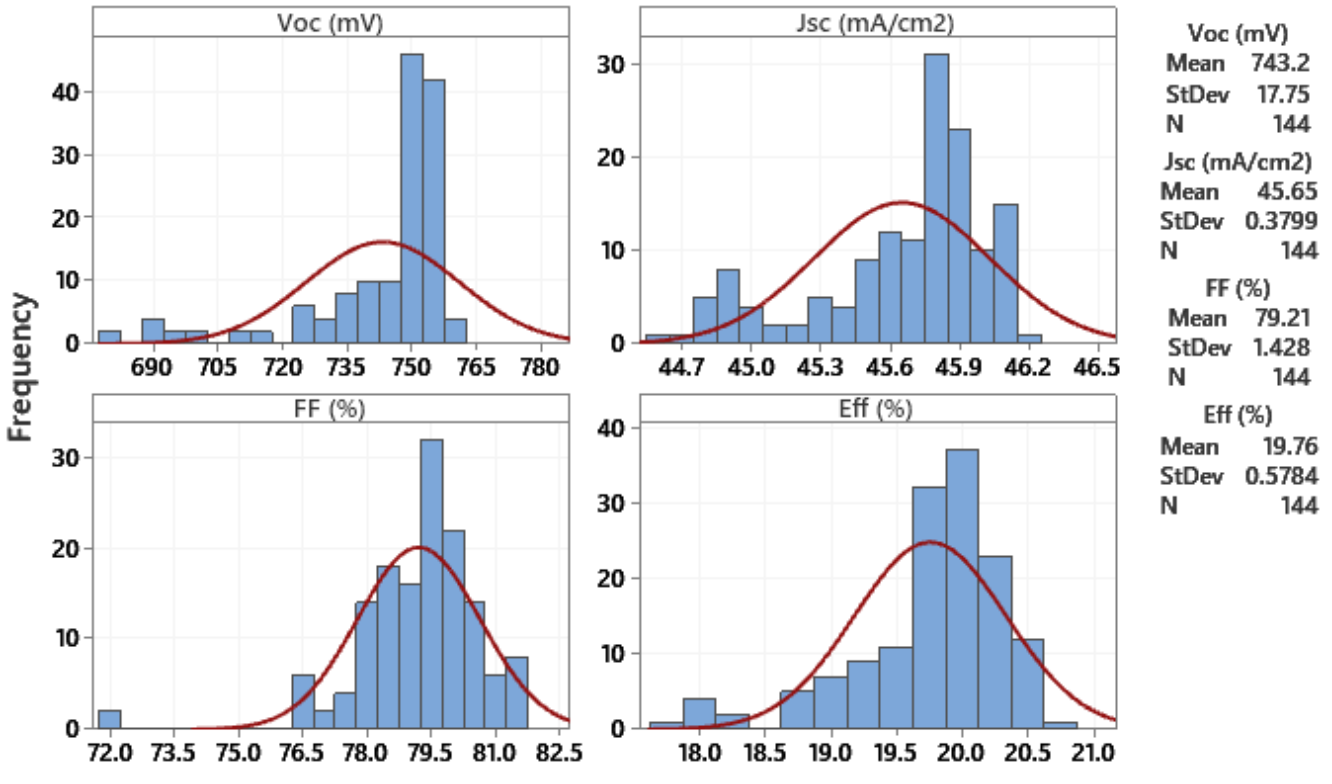


R&D Pilot Production

- 144 solar cells.
- Standard ‘space’ form-factor, 76 x 45 mm^2 area.
- 20% BOL AM0 efficiency.
- Current drop compensated by voltage increase.
- 0.26 g per cell, 3500 W/kg specific power.
- 10,000 W/kg potential with Si and Cu volume reduction.







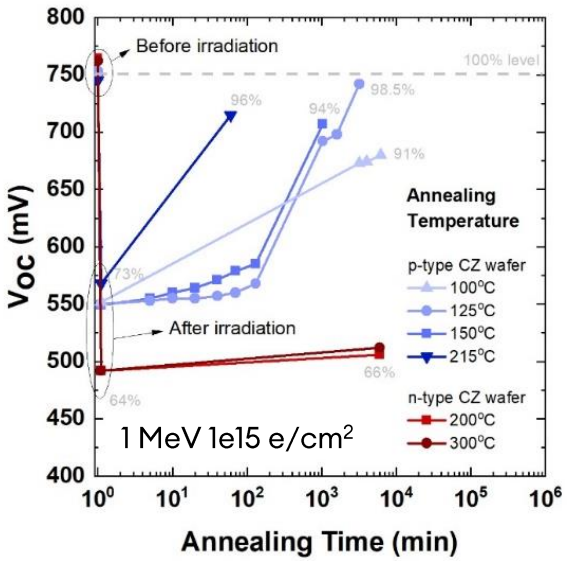
* Efficiency measured in-house using AM1.5 source with 1366 W/m^2 intensity at 28°C. Current adjusted for AM0 using QE.

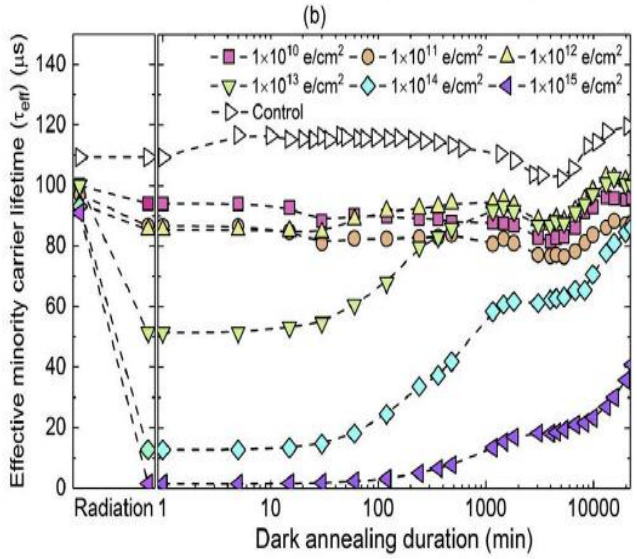
Radiation Hardness of Silicon

- Approach: promote defect reaction to (1) dissociate recombination active defects and/or (2) promote the formation of less recombination active defects.

Electron-Induced Defects

	Thickness (um)	T (°C)	EOL	Factor	Time (min)
Herasimenka[1]	20	100	700/750 mV	BO	5,000
Khan[2]	180	150	40/100 us	H	10,000





[1]S. Herasimenka, et al., presented at Space Power Workshop 2019.

[2]M. U. Khan, et al., Sol. Energy Mater. Sol. Cells 200, 109990 (2019).

Proton-Induced Defects

Key Findings:

- 100°C not sufficient to recover proton damage
- Illumination increases recovery rate