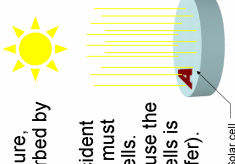


Stretchable Silicon Solar Cells

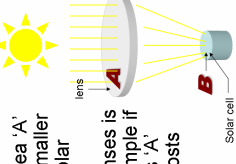
Rostam Dinyari, Kevin Huang, Jong-Yon Kim, Uraib Aboudi, Rishi Kant, Roger Howe and Peter Peumans
Stanford Organic Electronics Lab
Department of Electrical Engineering, Stanford University

Problem Statement

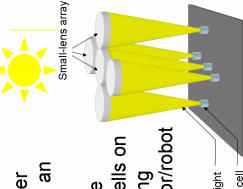
Traditional Cells – Problem

- In the simplest architecture, sunlight is directly absorbed by the solar cells.
 - Problem:** To use the incident light, the whole area 'A' must be covered with solar cells. This is expensive, because the fabrication of efficient cells is costly (\$1000 per 8" wafer).
- 

One Idea

- Use a large lens with area 'A' to focus the light to a smaller area 'B' covered with solar cells.
 - Problem:** Making big lenses is very expensive; for example if 'B' is an 8" wafer, a lens 'A' with an area 10 times costs thousands of dollars.
- 

Another Idea

- Cut the wafer into smaller solar cells and then use an array of smaller lenses.
 - Problem:** Placing a large number of small solar cells on exact locations and wiring them involves huge labor/robot costs (5 cents per cell).
- 

Cost

Photovoltaics today

\$2.5-\$3/Wp → ~\$0.25-\$0.30/kWh

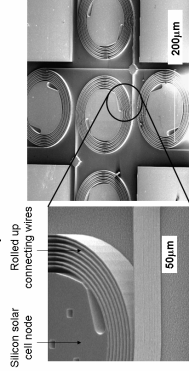
Microconcentrator with tracking

Efficiencies: 27% (Si), 36% (multijunction)
Multiplier: 1.37
\$0.24/Wp (semicond) + \$0.20/Wp (tracker) →
\$0.03/kWh

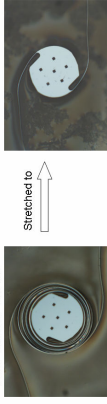
"Stretchable" Silicon Solar

Our Solution: "Stretchable" Silicon

- A network of solar cells with connecting wires Rolled up around them is fabricated.

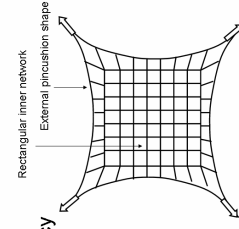


- The fabricated network is stretched open and each of the nodes is located at their required exact position. This will eliminate the labor cost.

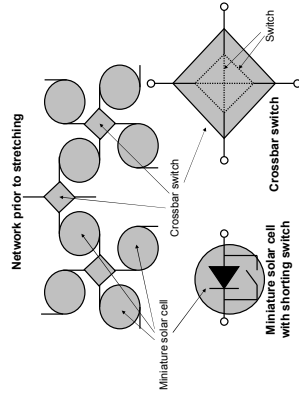


Mechanical Stretching

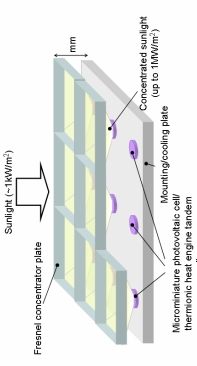
- Pincushion Effect
- Placement accuracy evaluation
- Immobilization



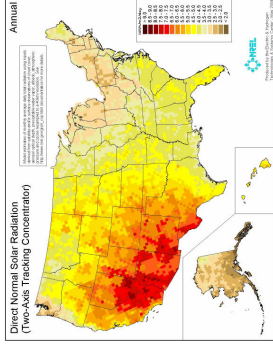
Integrated Logic



- An array of injection molded PMMA Fresnel lenses is used as the concentrator

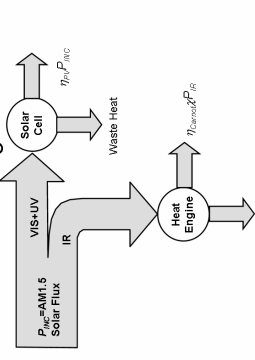


Concentrator: Available Power

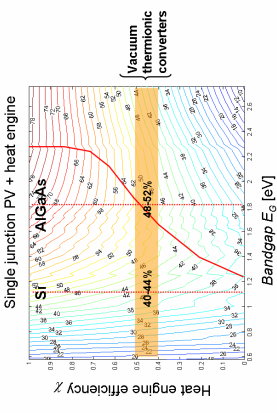


Solar Cell / Thermionic Converter Tandems

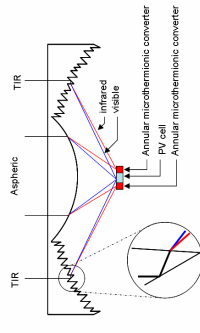
Photovoltaic/Heat Engine Tandem



Combined Efficiencies



Concentrator Design



Conclusions

- Have developed new approach to low-cost, high-performance solar cells
- Use expensive substrates
- But "stretch" them
- In a microconcentrator geometry
- Well-suited to
- Multijunction cells
- MEMS thermionic converters