Transmissible Laser Energy for Light Integrated Energy Storage Systems

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Introduction and Background

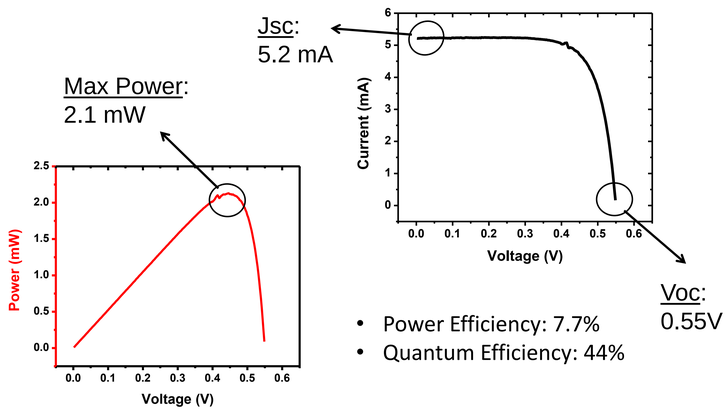
Each and everyday people need more and more sources of energy. Imagine being able to charge your phone within seconds and not being anywhere near an outlet. This project combines solar cells and pseudocapacitors, to make efficient energy storage that can be used quickly and remotely charged. By using a laser to charge this device, wireless remote energy transfers are going to soon be the new method of charging.

Objective

- Design and test a solar cell/pseudocapacitor combination device that can be remotely charged using a laser.

Testing of Laser

First we tested commercially available polycrystalline silicon solar cells with different lasers. Below we show the data obtained using the 532nm 28mW Handheld Laser.

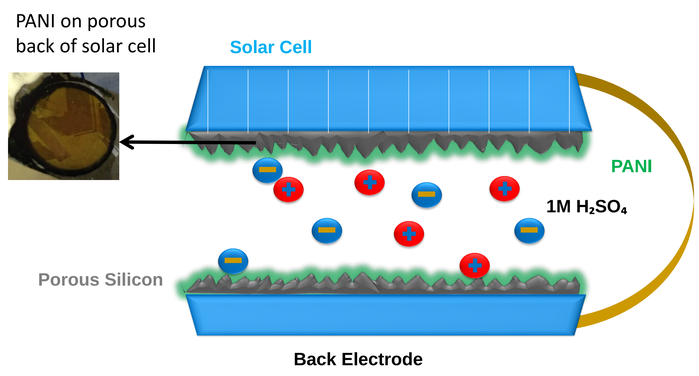


- Power Efficiency: 7.7%
- Quantum Efficiency: 44%

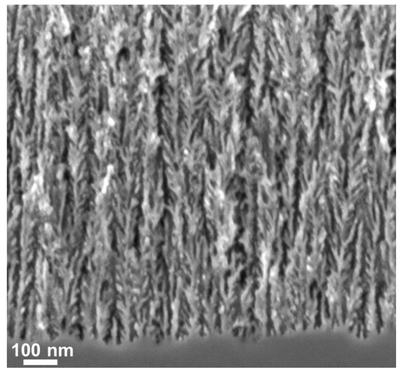
Methods

Starting with a cheap commercially available polycrystalline silicon solar cell

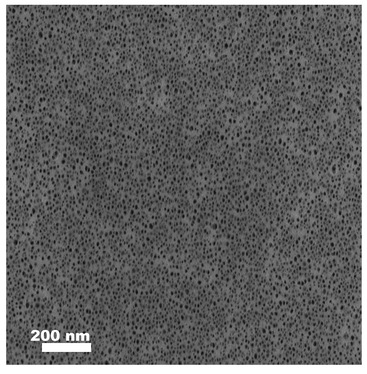
1. Etched nanopores onto the back of the solar cell to create a high surface area electrode for energy storage, and paired this with a porous silicon back electrode.
2. Deposited polyanalline on porous silicon to provide pseudocapacitance.
3. We used a 1M H2SO4 electrolyte and a polymer separator between the electrodes.



Profile of Porous Silicon (Side View)



Top View of Porous Silicon



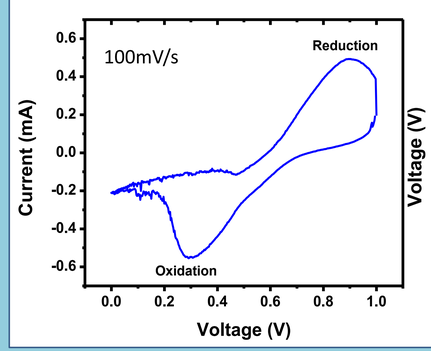
Results/Conclusion

This project demonstrated initial proof of concept that an energy storage can be created on a solar cell. Furthermore this device can be coupled with a laser for remote charging. This is the data that was able to be collected from the testing. :

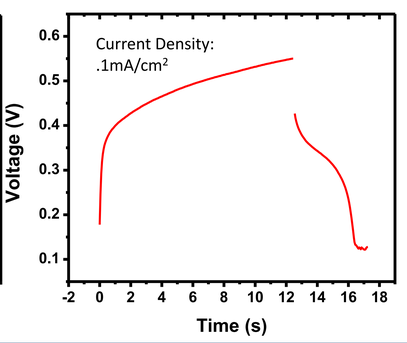
- The device could store energy up to 560 µWh/m^2

Testing of Supercapacitor

Cyclic Voltammetry



Charge-Discharge



Future Work

- Buy higher performing solar cells such as GaAs.
- Develop a solid state electrolyte
- Buy lasers that are better suited for our solar cells.

References and Acknowledgements

- Kawashima, Nobuki, and Kazuya Takeda. "Laser Energy Transmission for a Wireless Energy Supply to Robots." : 10. *InTech*. Web. 3 July 2014.
- Raible, Daniel, Dinca Dragos, and Taysir Nayfeh. "Optical Frequency Optimization of a High Intensity Laser Power Beaming System Utilizing VMJ Photovoltaic Cells." : 15. Web. 12 June 2014.
- Direct integration of a supercapacitor into the backside of a silicon photovoltaic deviceWestover, Andrew S. and Share, Keith and Carter, Rachel and Cohn, Adam P. and Oakes, Landon and Pint, Cary L., Applied Physics Letters, 104, 213905 (2014), DOI:http://dx.doi.org/10.1063/1.4880211

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