



# Novel Solar Cells

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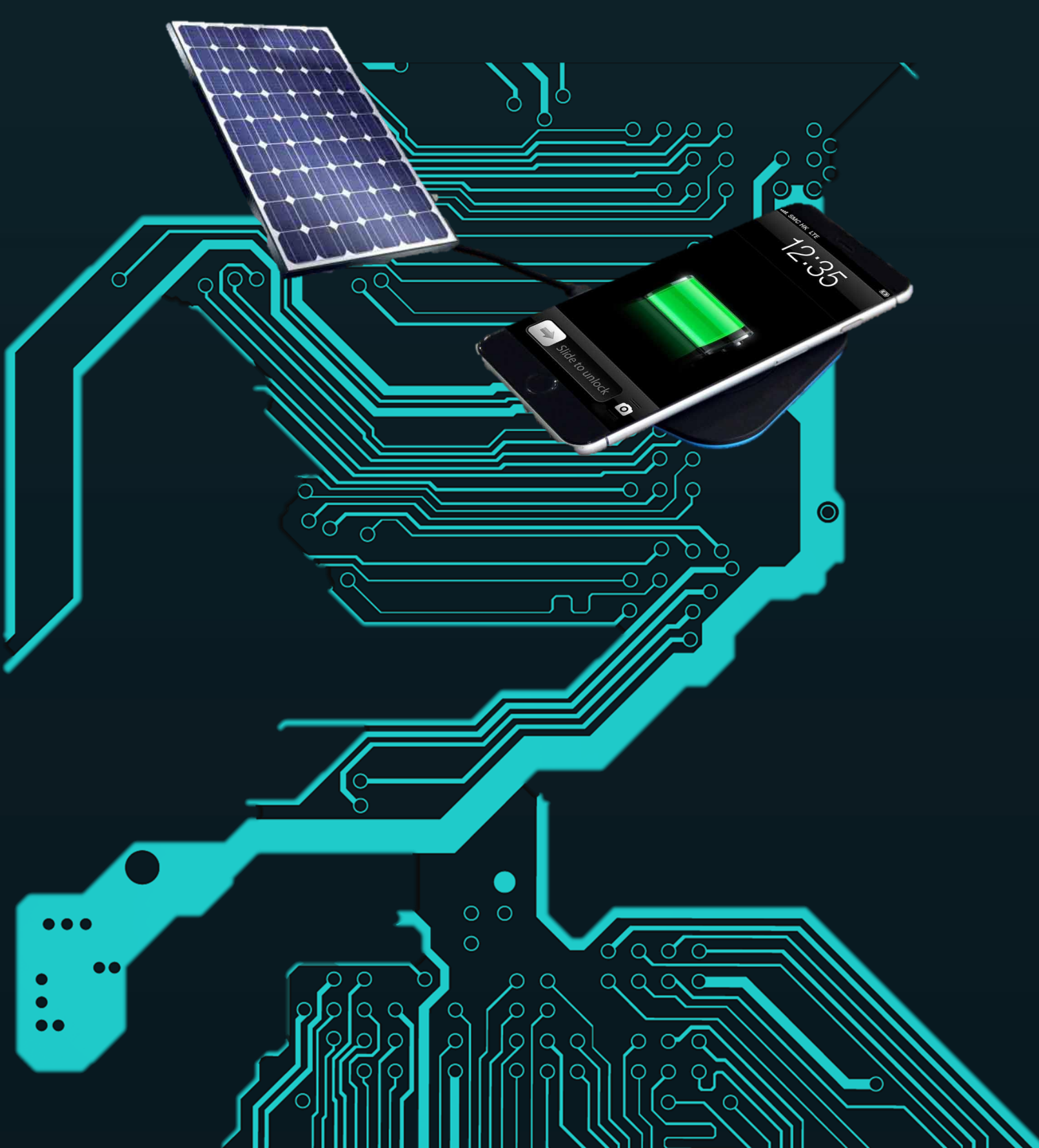


## Abstract

Solar cells are one of the most efficient sources of clean energy. Solar cells have come along way since 1954, when Bell labs produced the first silicon solar cell with an efficiency of 4%. However, modern silicon based solar cells can be very time consuming to manufacture/maintain and expensive. This has led scientist to focus on Organic Solar Cells (OSC). Solar cells work by absorbing sunlight and transferring electrons from a donor to an acceptor. The objective for scientist when researching new OSC is to create as little distance as possible from the donor to the acceptor. Scientist have been following a system of layers in which the acceptor sits upon the donor. A few years ago scientist found that instead of layering solar cells, the best way to transfer electrons from a donor to acceptor is to simply combined the two. By dissolving them, it creates an active layer that makes the distance and energy required for electron movement less. PCBM:P3HT has been found to be one of the most efficient donor acceptor relationship.

## Future Work

In the future we plan to take the solar panels and lithium battery and integrate them to a cell phone case. We predict that the cells can absorb a large amount of sunlight due to their effectiveness indoors. The cells hold up so it's not hard to see them being applied to other technology.



## Chlorophyll

To obtain the chlorophyll, we weighed six grams of spinach and added 10 mL of acetone. We then proceeded to crush the chlorophyll until the spinach was a pasty solution. The solution was drained and vacuumed through a paper filter into a beaker. We then took a syringe and more precisely transferred the chlorophyll into a vial, leaving all solids behind.

We used FTO glass, FTO is a clear conductive coating applied onto the glass. To clean the glass we used DI Water and Acetone. We applied tape spacers 1mm from each side and 5mm from the top to allow a clean connection later on the conductive side of the glass.



A thin sheet of Titanium dioxide (TiO<sub>2</sub>) was also spread on the conductive side of the FTO glass. In order to prepare the TiO<sub>2</sub> we mixed 15mL of Acetic Acid and 1 gram of TiO<sub>2</sub> until the solution became pasty. The tape was removed and the cell was left on the hot plate 180 degrees Celsius for 3 hours. After the TiO<sub>2</sub> Had Dried, We put our chlorophyll extract on top of the TiO<sub>2</sub> and left the cell in complete darkness until the next day.

The electrolyte was synthesized by measuring 830mg of potassium, 127mg of pure Iodine crystal, and 10mLz Ethylene glycol. We left the solution to mix for approximately 1 hour. Next, we prepared the top FTO glass by elevating it above a candle flame to apply a carbon coating. We removed the carbon with the same dimensions applied by the tape earlier.

The electrolyte was applied on top of the coat of chlorophyll the next day. The carbon layer was put on top of the entire cell and held tight with clips on both sides,.



## Cathode

The cathode we used was Lithium Iron Phosphate (LiFePO<sub>4</sub>). We used Iron Phosphate, Phosphoric Acid, and 2g of Ascorbic Acid. We poured these into beaker holding 50mL of DI Water. Lithium Hydroxyde was also added with 30mL of DI Water. We mixed these two separately with a stir bar for an hour. We then mixed these two products until the solution texture became a gel. We placed the solution into a Bomb Calorimeter at 180C for 3 hours. The solution was extracted from the Bomb Calorimeter and put into a filter. We poured and filtered 30mL of DI Water 15 times. Our product became a powder.

## Results

can output up to 5.6 V. The cells worked very well and exceeded all expectations, we believe that with enough surface area we can absorb enough energy to power and charge a cell phone.



## HeteroJunction Organic Solar Cell

We cleaned the glass by supersonicating all pieces used in soap for 30min. We then supersonicated the glass in DI Water for 30 min to ensure all soap was removed from the glass. Lastly, we supersonicated the glass in Acetone for 30min. We found the conductive side of the glass with a Volt-meter and applied a thin line of electrical tape over the center of the conductive layer since all the surface area provided wont be needed. To remove the unneeded ITO, We put Hydrochloric Acid to boil and dropped the glass in the acid for 7 seconds.

We measure 6 grams PCBM and P3HT in a 1 to 1 ratio. We added 10mL of Chlorobenzene and mixed for approximately 4 hours. We prepared the TiO<sub>2</sub> the same way as the chlorophyll solar cell. The TiO<sub>2</sub> was applied to the sheet of ITO that was not removed. We left the TiO<sub>2</sub> to dry and then applied the PCMB to the cell. The cell was transferred to a hot plate at 120C and left to dry. The cell of taken off and left to cool down slowly at room temperature. We covered to PCMB with a thin layer of silver paint. We applied a copper sheet the same dimensions as our cell quickly while the paint was still wet.

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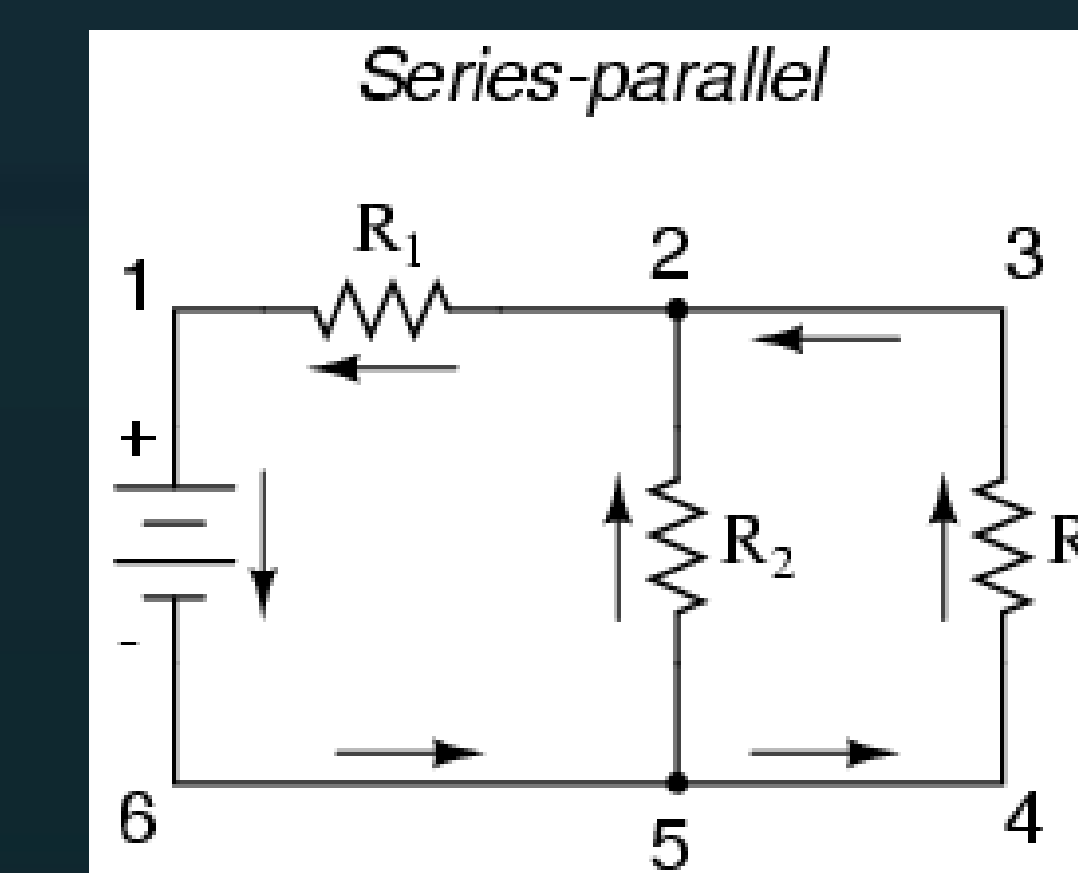
## Acknowledgements

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## Cuircuts

We researched the basics of circuits and types of connections that are used in wiring. Parallel and Series are two types of connections used. Both have pros and cons. We found that in parallel, voltage will remain constant while amps go up. In series, amps will remain constant while voltage goes up. We used an Iron Solder to connect our circuit together. Lead was used to connect the wires to the glass. But since the glass had an ITO layer the lead would not stick.

To solve this we use silver conductive paint and applied it to the ITO where we would be connecting the copper wires.



Material	Voltage/efficiency	Lasting
Chlorophyll	.6v / .01%	1 week
Heterogeneous	2.2v / 4.2%	5 years
Li Battery	3.6v	500 cycles

