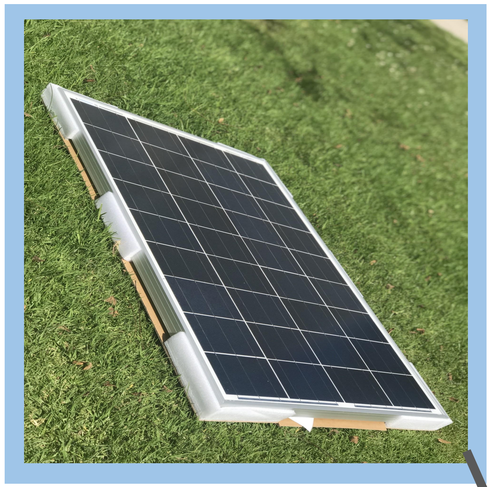
Fuel Your Sol: Design of a Unitized Hydrogen Fuel Cell

Project Managers: Bryan Thai, Susie Park
Members: Hannah Kim, Daniel Kupor, Oswah Sarwar, Nick Dorn, Joyce Shen

Solar Power



Background:
Building off of the success of previous AIChE Project teams, notably the Campus Renewable Energy's solar umbrella, we chose to take a different path and focus on energy storage.

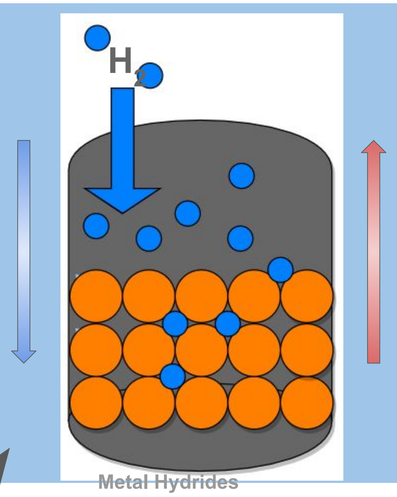
We begin with a solar panel, which takes solar energy and converts it into electrical energy to be utilized. We plan to have two alternate paths for the energy to take: if a phone is plugged in, the solar panel will ideally directly charge the phone to increase efficiency, while if not it will power the electrolysis reaction to produce hydrogen.

H_2 Generation

Our current design also includes a separate component for the hydrogen generation. The electrolytic cell we've created below makes use of Potassium Hydroxide (KOH) as the electrolyte, which facilitates the creation of hydrogen and oxygen gas.
A nafion membrane between the anode and cathode separates the products, allowing for ease of use.
Electrical current introduced to the two electrodes induces electrolysis into the alkaline solution which initiates the decomposition of water.

Anode: $4OH^- \rightarrow O_2 + 2H_2O + 4e^-$
Cathode: $4H_2O + 4e^- \rightarrow 2H_2 + 4OH^-$

H_2 Storage



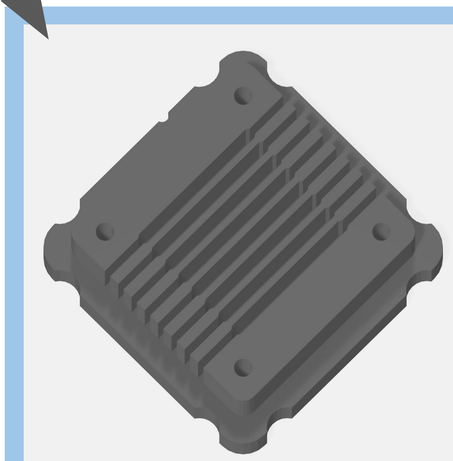
Hydrogen Storage:
Once the hydrogen is separated it is to be stored for later use. Conventionally, hydrogen may be stored as compressed gas or as a cold liquid. For our purpose of implementation, these methods may not be safe since those components are volatile and flammable, thus requiring a sturdy container.

We want to use metal hydrides, such as $LaNi_5$, to store our hydrogen since the method is reversible and can be operated at a reasonable temperature and pressure.

Fuel Cell

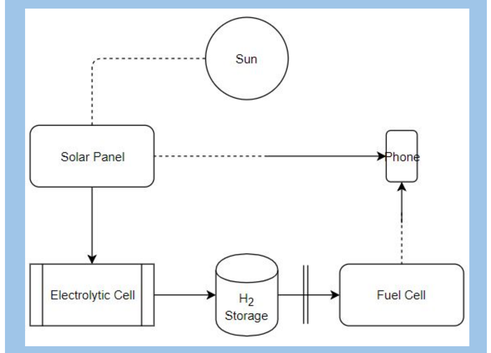
Fuel Cell Design:
The design of the fuel cell is what's known as a bipolar plate which allows for the stacking of each cell in series so as to increase the output voltage. The top half as shown below is designed to permit a uniform flow of oxygen across the cell while the bottom half consists of a winding channel for the hydrogen gas to pass through.

Contact between the two gases occurs across a polymer electrolyte membrane which facilitates the reaction to produce electricity and water vapor.



Overall

**not drawn to scale



Fuel Your Sol aims to utilize solar energy and hydrogen fuel cell technology to address the modern day concerns of sustainable energy sources.
These fuel cells can serve as an alternative to fossil fuels making them efficient and environmental friendly.

The design is still under development, but we hope that it will serve as an accessible phone charger to the students and faculty on campus.

Progress and Future Direction:

Over the last year, we've finished construction and testing of our electrolytic cell and have determine its capability of producing adequate amounts of H_2 gas to power the fuel cell. Likewise, we've also determine the exact metal hydride we wish to pursue in order to develop our H_2 storage unit: $LaNi_5$. Over the course of the next year, we intend to finalize our design for the H_2 storage unit and begin initial prototyping that will progress towards a completed containment unit. At which point, we intend to begin system integration and circuitry to connect the electrical components such as the solar panel and charge controller to the chemical components such as the electrolytic cell and H_2 storage tank using the fuel cell as the medium between the two. The completed system would be housed in a seating area such as a bench and placed on campus for all students to use.