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The Use of an Oxygen Evolving Complex in the Production of Hydrogen Fuel

In 2010, Americans consumed a total of 19 million barrels of oil, *per day* (United)*.* There have been many plans for ways to reduce this number, due to a decrease in the expected amount of resources. One such plan, called hydrogen fuel, is based around the concept of using H2 combined with 2O2 to produce 2H20 and energy. While this is a great idea on paper, it is relatively useless, because the most common method for producing H2 is called steam reforming, and requires fossil fuels. I propose a new method based on biological processes that use photolysis to split H20, and then reduce the produced ions into hydrogen gas.

Hydrogen fuel is often regarded as the future of energy production, and for good reasons. Hydrogen ions can be used for energy with a much higher efficiency than traditional sources. It can convert nearly 75% of the energy in the fuel, as opposed to about 35% in an internal combustion engine (Hydrogen). Hydrogen fuel cells work by having an anode and cathode separated by a membrane. The H2 gas is added to the anode, and 02 gas is added at the cathode. They are separated by a membrane that will allow only protons to pass through. The H2 gas, when exposed to the positively charged becomes a reduction agent to the anode. The produced H+ ion passes through the membrane, combines with the O2, and becomes reduced again from the cathode to form water. The anode and cathode now have a difference in charge, and produce an electrical current. Water is the only byproduct, making this reaction both efficient and ecologically safe.

In photosynthesis, photolysis is used to produce electrons and protons from water. The Oxygen Evolving Complex (OEC) is an inorganic catalyst that uses photons to deform itself and decompose water. In the process, it produces 4 electrons that are used in redox reactions to produce ATP. However, these electrons can be used instead to reduce the hydrogen and produce hydrogen gas. These enzymes could theoretically be used outside of Photosystem 1 and daisy-chained together in order for one OEC to oxidize the H+ ions of another OEC. By placing these on top of a thin membrane, the produced hydrogen gas can escape into a sealed container for use (See Figure 1).

The improved source of hydrogen could be useful in many regards, but perhaps the most straightforward result is in the use of hydrogen-powered vehicles. Given the high prices of gas, an alternative source of power is very often sought after. Another use of this technology could be as a backup generator. The efficiency of this process is proportionate to the surface area, and could therefore be put on the roof of a house to utilize rain (as a source of water), and the natural light from the sun to provide fuel for a backup generator in the house.