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May 4, 2020

CHEN E3810

Lab Final Assessment

Topic: Renewable Energy – Solar Cell to Hydrogen Fuel Cell

The world has long known an energy crisis could soon be upon us. New technologies are constantly being developed and improved in hopes of finding an answer to the problem. One of the most promising solutions is renewable energy, specifically the use of solar cells. Across America, private and public sectors have turned to solar technology to alleviate energy costs as well as promote renewable sources. New York City, for example, has increased its solar capacity to currently reach sixth in the US for installed solar cells[1]. Recently StuyTown in Manhattan completed installation of over 9,000 solar panels producing around 3.9 megawatts. Initiatives like this, as well as technological improvement will help the world shift to renewable sources. The average efficiency of new PV cells is around 20%[2]. This efficiency can vary. In a lab test, a solar panel had just 7.26% efficiency when exposed to a light source just 20cm away. Commercially available PV cells can reach up to 23%, which is enough to be effective in providing renewable energy.

Although solar technology has improved vastly over the recent decade, it is still not enough to start a major shift in energy reliance. Solar power heavily relies on location. Both solar irradiance and weather patterns have a major impact on energy produced. A house in New York City will experience on average around 4.0 $kWh/m^2/day$ while a house in Arizona will can receive over 7.5 $kWh/m^2/day$.[3] Therefore, it cannot be a reliable energy source on its own, because it is not consistent. The house in Arizona could very likely produce more energy than needed, while the house in New York City will still rely on energy from a different source in addition to the solar panels. An intermediate is needed to store

energy. A viable solution is to convert the excess energy into a readily available source, such as hydrogen. Lab tests have shown an efficiency of 85.7% utilizing a PV cell coupled with an electrolyzer.

The feasibility is still low of having a home be self-sufficient in terms of energy. One man in New Jersey was able to accomplish a house completely off the grid using solar panels, an electrolyzer, and fuel cells. However, this project cost over $500,000 and 56 solar panels on an 11-acre plot of land.[4] Despite this, small scale solar panel and electrolyzer systems are a much more realistic possibility. Although they will not completely eliminate the reliance on fossil fuels, they certainly can decrease the reliance on non-renewable energy. Experimental results showed a $30m^2$ PV cell unit could power a 300kWh/month system for a two-year period given an initial hydrogen storage of around $2,267m^3$. This system used a panel with just 7.26% efficiency. With a more advanced solar cell, the hydrogen requirement will be much lower.

Another promising technology emerging for producing hydrogen gas is Natural Gas Reforming. As the name suggests, natural gas is reformed with hot steam to create hydrogen.[5] The process is inexpensive, efficient, and can be done on a large scale from the excess supply of natural gas. In the near future America can witness a rise in homes powered by hydrogen gas.

Future lab experiments on renewable energy can benefit from examining the energy efficiency of natural gas reforming, and compare it to the efficiency of a solar cell/electrolysis system.

References

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