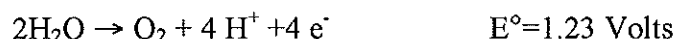


Applicant: Ryan Pekarek  
Advisor: Dr. Nita A. Lewis

### Can Cheap Copper Save the Planet?

Every night, we are irresistibly drawn to the television to watch the nuclear disaster unfold in Fukushima, Japan, after a terrible earthquake and tsunami damaged the nuclear plants, leading to the possibility of dangerous radiation levels. This reminds us of the 1986 Chernobyl incident that blew a nuclear cloud around the world (BBC). We also recall the *Deep Water Horizon* incident in the Gulf of Mexico that demonstrates the difficulty and danger of fossil fuel based energy. Furthermore, it is estimated that the planet's oil will be depleted in 50-100 years (Tro, Nivaldo; *Chemistry: A Molecular Approach*, 2<sup>nd</sup> Ed., Prentice Hall, 2011 pg. 264). It is obvious that we need to move quickly to an economy that is based on renewable energy sources.

Water is an abundant and renewable resource that plants use in photosynthesis. The chloroplast of a leaf cell splits water by the equation below with a magnesium catalyst, which is then regenerated by the photons coming in as sunlight.



The energy released far exceeds what most other reactions can accomplish. The major difficulty in employing this reaction as an energy source is the expensive catalyst required for the movement of four electrons. Professor Harry Gray, an expert on the subject at The California Institute of Technology, points out that the necessary catalyst needs to be "non-toxic, abundant, and inexpensive."

I have spent the current semester with Dr. Lewis synthesizing the protein His-2. These proteins are being synthesized in order to create nanowires used for tiny robots called nanobots. The His-2 creates a chain of two copper atoms called a copper dimer. Although two atoms is short even for a nanowire, we have observed the complex oxidizing water stoichiometrically. This means that it will undergo the above reaction once. Over the summer, I would like to determine if the copper complex can be made to perform the above reaction catalytically and therefore continuously undergo the reaction. If successful, an inexpensive and efficient source of energy would become possible for the first time. We realize that many groups all over the world have spent decades working on this problem and it is likely that the initial molecule will have to be modified to achieve this objective.

I came to the University of Miami on a music scholarship with the intention of taking the required premedical classes and continuing to medical school. Now having taken a substantial number of biology and chemistry courses, I realize that the knowledge of chemistry allows for the understanding of life and industrial processes at the most basic level. Nature has been the inspiration of invention since we learned to modify our surroundings. I would like to become a researcher who solves society's problems by looking to the environment. The race to end our dependency on fossil fuels is competitive, but by funding this research, the University of Miami can become a frontrunner in the development of a cleaner and safer energy alternative.