# CALIFORNIA STATE SCIENCE FAIR
# 2013 PROJECT SUMMARY

**Name(s)**

**Dante Monaldo**

**Project Number**

**S0617**

**Project Title**

## Discovering the Most Cost-Effective Catalyst for Efficient Energy Storage through Electrolysis

**Abstract**

**Objectives/Goals**

The purpose of this experiment was to determine the most cost-effective catalyst for electrolysis. The null hypothesis states that the cost to produce one mL of hydrogen and oxygen gas will be the same for all the tests performed. The alternative hypothesis states that the cost to produce one mL of hydrogen and oxygen gas with zinc oxide plated electrodes will cost the least out of all other tests performed.

**Methods/Materials**

The metal compounds used in this experiment included cobalt oxide (C3O4), nickel oxide (NiO), zinc oxide (OZn) and copper oxide (CuO). Each metal compound was electroplated onto two pairs of platinum electrodes and placed in a graduated Hoffman apparatus with 1.16g of potassium phosphate monobasic (H2KO4P) as a buffer. Tests were run for 4 hours per electrode pair. Volumes of gases produced, ambient room temperature and water pH measurements were recorded.

**Results**

The results for each set of tests were averaged and the data was analyzed. The control tests with platinum electrodes produced 23.65mL and 10.70mL of hydrogen and oxygen gas, respectively. Cobalt oxide plated electrodes generated 23.05mL/10.32mL and nickel oxide produced 22.50mL/10.05mL. Zinc oxide produced 20.15mL/9.05mL and copper oxide produced 20.05mL/9.00mL. The zinc oxide and copper oxide catalysts corroded the quickest and produced less gases. Nickel oxide costs less than 29% the price of cobalt oxide, and less than 1% the price of platinum. While cobalt oxide was the most efficient catalyst, nickel oxide cost the least per mL of hydrogen and oxygen gas produced.

**Conclusions/Discussion**

The data showed that neither hypotheses were supported, but also allowed for the discovery of nickel oxide as a more cost-effective catalyst. These results can be used in further research to continue to isolate cost-effective catalysts for electrolysis while maintaining the overall system efficiency. This knowledge can also be applied to future electrolysis systems in which hydrogen and oxygen gases are later recombined in PEM (proton exchange membrane) fuel cells to release electrical energy.

**Summary Statement**

Tested the effects of certain metal compounds to discover a more cost-effective catalyst to replace the expensive platinum electrodes currently used in electrolysis.

**Help Received**

I borrowed a lab power supply from De La Salle High School.