CALIFORNIA STATE SCIENCE FAIR
2011 PROJECT SUMMARY

Name(s)

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Project Number

31013

Project Title

How Do Various Electrolytes, Polyatomic & Monatomic, Affect Charging/Discharging Efficiency of Algae Based Batteries?

Abstract

Objectives/Goals

The objective of our project is to compare two polyatomic and two monatomic electrolytes, in order to ascertain the most efficient algae based polymer battery. The monatomic electrolytes include sodium chloride and sodium iodide. The polyatomic electrolytes include sodium benzoate and sodium sulfite. Our hypothesis is: If monatomic and polyatomic electrolytes are used in an algae/Polypyrrole battery, then the charging/discharging efficiency of monatomic electrolytes will be superior.

Methods/Materials

After months of developing environmentally green battery electrodes, we were able to successfully construct functional batteries. The batteries were produced from the high specific-surface area cellulose, which was extracted from Cladophora algae. This high specific-surface area cellulose was utilized along with Polypyrrole, a conductive polymer, to create electrodes. When a layer of Polypyrrole was deposited onto Cladophora cellulose fibers with the help of iron chloride, the resultant was a mechanically stable and conductive paper sheet. Five different electrolytes were then tested with these electrodes to make batteries. These batteries were characterized using galvanostatic cycling, cyclic voltammetry, and open circuit voltage and current tests.

Results

The most efficient electrolyte, when used with Pyrrole and cellulose electrodes, was sodium benzoate. Sodium benzoate had the highest charge return of 76.4%, and the second highest open circuit voltage of 0.350 Volts. The second most efficient electrolyte was sodium sulfite with a charge return of 13.3%. The open circuit voltage for sodium sulfite was by far the best with a 1.15 V average. Both of these electrolytes have polyatomic anions.

Conclusions/Discussion

In conclusion, from the data collected from this experiment polyatomic electrolytes are more efficient than monatomic electrolytes in algae based polymer batteries. Our data contrasts our original hypothesis that monatomic electrolytes would increase the charging and discharging efficiency of these batteries. In general, it appears that after multiple charge and discharge cycles, the anions intercalated more readily into the polymer. The algae based composite material shows promise in ion-exchange capacity and cycling stability when used as a working electrode in an electrolytic solution.

Summary Statement

How do various electrolytes, polyatomic and monatomic, affect charging and discharging efficiency of algae based polymer batteries?

Help Received

We used lab equipment at University of California Santa Barbara under the supervision of the graduate student, Alan Derk.