CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)
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Project Number
S1711

Project Title
Virus-Based Lithium Ion Batteries

Abstract

Objectives/Goals
This project was done to create fully functional nanowires that could be used as a battery electrode. An objective is that the synthesized nanowires be uniform in structure.

Methods/Materials
A bacteriophage (a virus that specifically infects bacteria) is used as a template for creating precisely positioned materials. The bacteriophage becomes a template when the functionality of certain proteins are changed through genetic modifications in the M13 bacteriophage's genome. Because of the addition of a tetraglutamate to a specific protein, FePO4 will bind to the phage. The resulting clone is named E4.

Results
The nanowires formed by binding FePO4 to the E4 phage are more environmentally friendly and less costly to make than existing FePO4 battery components. The FePO4#E4 battery is almost completely biodegradable also. The only part of the battery not biodegradable is the electrolyte. The virus-based batteries could hold any voltage, except that the electrolyte for lithium ion batteries is only stable from approximately 1 volt to 5 volts. The virus-based batteries are also rechargeable, meaning they are not just one use.

Conclusions/Discussion
These virus-based batteries are both environmentally friendly and economical. They will last longer than other commercially available batteries and help to create less waste for the future. The nanowires can be used to build batteries applicable to most aspects of life requiring a power source.

Summary Statement
Genetically modifying a bacteriophage to produce nanowires for a battery electrode.

Help Received
Used lab equipment at Massachusetts Institute of Technology under the supervision of Professor Angela Belcher and Mark Allen PhD.; Neighbor Eric Acree helped with wire display; photos taken by Diane M. Kaufmann