CALIFORNIA STATE SCIENCE FAIR
2002 PROJECT SUMMARY

Name(s)
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Project Number
S0506

Project Title
An Alternative Method for Fabrication of Semiconductor Nanorods

Abstract

Objectives/Goals
The objective is to find an alternative method for fabrication of semiconductor nanorods. A template-method, whereby two solutions are diffused across a semi-permeable membrane (Nucleopore#), will allow two solutions to deposit their precipitate directly in the pores of the membrane.

Methods/Materials
Nucleopore# membranes, vials (plastic 1.5ml), pipettes. Lead (II) Nitrate solution (.1 M solution, to be diluted), Potassium Iodide solution (.1M solution, to be diluted), Chloroform, UV goggles, a power drill, a quick clamp are needed to manufacture the nanorods. A Scanning Electron Microscope(SEM) and a Luminescence Spectrometer are needed to analyze the sample.

Procedure:
First, the diffusion rates must be balanced; this requires varying of solutions to produce a detectable precipitate and varying of concentrations to balance diffusion rates. Confirmation of filled pores can be done by using a SEM or an optical microscope. The second step in this project is to verify the shape of the crystals. Place the membrane in cholorform and analyze it under a microscope. The last part of the experiment is to verify the semiconductor characteristics of the material. An ultraviolet light is used to excite the sample to show that there is an energy band gap. Additionally, a Luminescence Spectroscopy was done on the Lead (II) Iodide to test for a shift of the spectrum under different temperatures.

Results
Lead (II) Iodide is best candidate for this experiment because it fluoresces and can be easily detected by eye. Concentrations of .01M for Lead and .03M for Iodide balances the diffusion rate for 5 micron pores. However, this set of concentrations seems to change a little as pore sizes are varied . Rods are found under a microscope and the material#s light spectrum when shifts to higher energy with lower temperature.

Conclusions/Discussion
The diffusion method works for fabricating semiconductors. Precipitate in the membranes are cylinder-formed. The bulk sample, however, does not contain nanorods. Luminescence Spectra shows that Lead(II) Iodide#s band gap shifts towards higher energy at a lower temperature; this is a characteristic of a semiconductor. Variation of concentrations for balanced diffusion rates leads to a possibility of Cation-Permselective Behavior. The Lead (II) Iodide semiconductor nanorods might replace Cadmium Sulfide as a semiconductor because their energy band gaps are similar.

Summary Statement
Using the diffusion method, nanorods are created inside of a template; through testing of semiconductor characteristics, these nanorods show properties of being a semiconductor.

Help Received
I used a Mitutoyo optical microscope with a CCD camera, a Phillips field emission gun scanning electron microscope and obtained data from a microprobe luminescence spectrometer at University of California, Irvine under the supervision of Dr. Mike Zach.