INTRODUCTION

Nanotechnology is the study of matter on an atomic and molecular scale. As the name suggests, nanotechnology deals with structures on the scale of nanometers.

The list of applications of nanotechnology is ever expanding. Areas such as medicine, Chemistry, Energy, Communication and many more are all using nanotechnology to their benefits. The focus of IPRO 317 is to deal with silver nanorods and their applications. More specifically, the use of silver nanorods as thermal history indicators are exploded, focusing on large scale production through a continuous flow process.

ABSTRACT

Metallic particles exhibit shape-dependent optical properties. Non-spherical nanoparticles are unstable and tend to revert to nanospheres over time. Silver Nanorods are produced by direct chemical synthesis. Their color change is a function of time and temperature and for this fact, silver nanorods are exploited to create thermal history indicators.

For commercialization of silver nanorods, the method of synthesis must be converted from the current, lower yielding, small-scale batch process to a higher yielding continuous process.

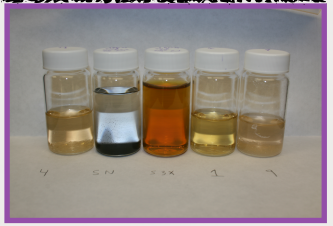
IN THE LAB....

Lab procedure needed to be followed very precisely due to the tedious measurements of chemicals and reagents that were required to ensure proper results. The experiments required at least 5-7 hours of work to allow seed and growth solutions enough time to sit and become most reactive. Color changes were observed. These changes indicate the desired reaction. To determine if nanorods had been made and to separate them from the solution, a centrifuge was used and a rapid spin is used to test the validity of using rods as thermal indicators. Trials were set up at different temperatures to determine the color change ability of the rods. From this, it was concluded that the rods were a good source of thermal history indication.

RESULTS

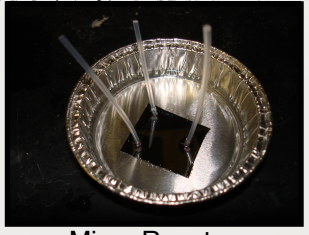
In the end, the lab group was able to make a batch of nanorods and then turned to phase II of the project which is creating a constant flow process. Using a micro reactor with long tubing and having a concentration gradient at the very center of the tube, the rods were to be formed there. Unfortunately, the creation of nanorods using this process was not successful.

Batch Process



Color changing batch

Continuous flow



Micro Reactor

APPLICATIONS

- Surface-Enhanced Raman Scattering (SERS)
  - Rapid, sensitive pathogen detection. (e.g Human immunodeficiency virus (HIV), Rotavirus, Mycoplasma pneumoniae, Escherichia coli)
  - Detection of trace organics (concentrations of 10^{-14} mol/L)
  - Identifying rock composition.
- Silver "Mirror" in Microscopy
  - Reveal internal structures of biological materials. (e.g Bones, Tumor cells)
  - Detect fatigue in materials (e.g Carbon-fiber plastics (aircraft parts))

ECONOMICS

This project has been deemed to be economically viable. The cost per batch and quantity of nanorods to be bought were taken into consideration along with the labor costs and other miscellaneous costs. The total cost per batch summed up to 5 cents which is less than a dollar. But not to be mistaken, if this were to go large scale, the number of batches produced will subsequently increase the total cost.

IPRO It takes a team!

INTERPROFESSIONAL PROJECTS PROGRAM

Research Group

Lab Group

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Created and designed by Kunle Apampa

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IPRO 317

SILVER NANORODS

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