IPRO 348
Silver Nanorods as Indicators of Thermal History

How Thermal Indicators Can Prevent Food Borne Illness

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Problem Statement

There are many perishable products requiring stringent, low temperature storage conditions

- **$152 billion annually in US[1]**
- **US and abroad[2,3]**
- **88% non-produce[4]**

References:
1. http://www.reuters.com/article/idUSTRE6365HU20100407
2. Cnn.com, Monday, Aug 18th, "Spoiled food behind NYC illness".
3. Hundreds of children hospitalized in Ukraine's Capital", AP World stream, March 21, 2004
4. Centers for Disease Control Data

Why Silver Nanorods?

*Silver Nanorods: Small particles, with a physical shape that changes with **time** and **temperature**.*

- Educate Consumers
  - Individual package
  - Box of vaccines
  - In transport

- Spring 2009 IPRO
  - Ideal synthesis volume
  - Estimated label to be cheaper
  - No control of color change

Objectives

- Improve procedure for optimal production
- Evaluate risks, technologies, and applications
- Process design and scale-up
- Create a prototype
- Evaluate cost and competitors
- Mentoring chemical engineering 296 students

Development and Performance

- Team logistics and communication
- Team values statement, tasks, timeline and goals
- Peer reviews, timesheets
- In-class updates
- Adapted to change
  - Created two lab groups
  - Narrowed-focus
  - Changed our groups

Team Organization

Lab
Experimentation and analysis

Prototype
Design a thermal indicator

Research
Investigate and evaluate new applications for silver nanorods

Scale-Up
Design a process for increased production

Ethics
Investigate ethical issues surrounding nanorods

Business
Economic analysis and design

New Team Organization

Prototype

Poster and Brochure

Final Report

Presentation

Final Research

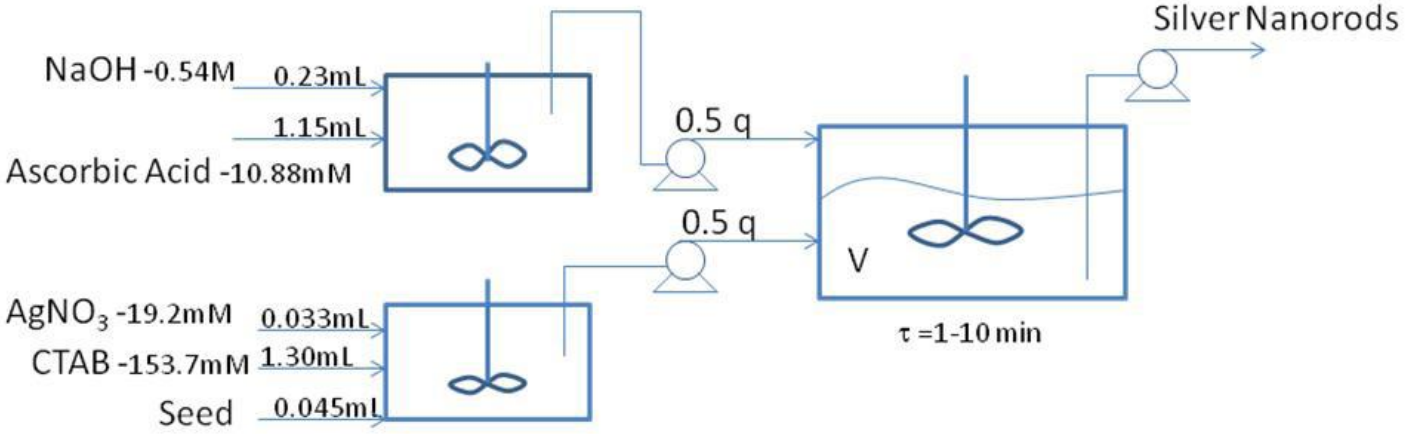
Project work: Lab

- Improved synthesis
- Experimentation
- Spectroscopic analysis
- Challenges:
  - Published protocols incomplete
  - Lab scheduling

First group at IIT to consistently create silver nanorods!

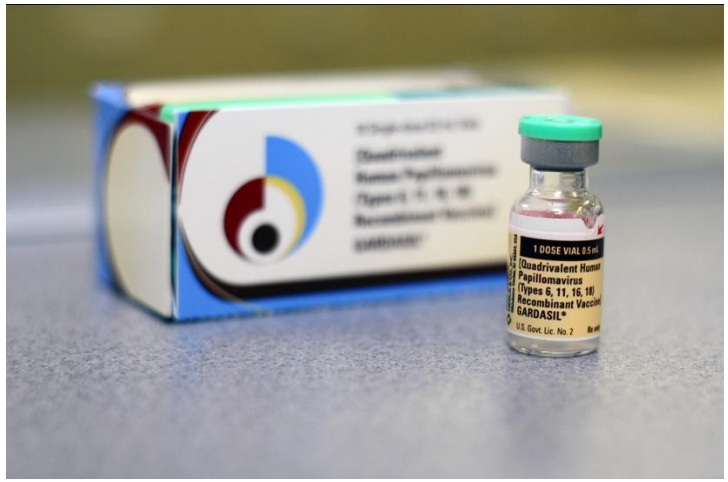
Project work: Scale-Up

- Academic research
- Scaled-up
- Tested and modified
- Continuous flow process
- Equipment restrictions



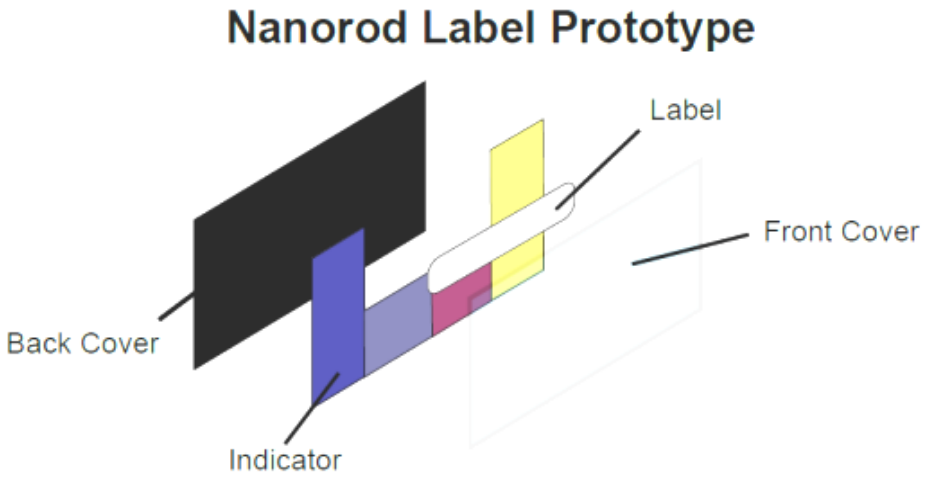
Project work: New Technology & Ethics

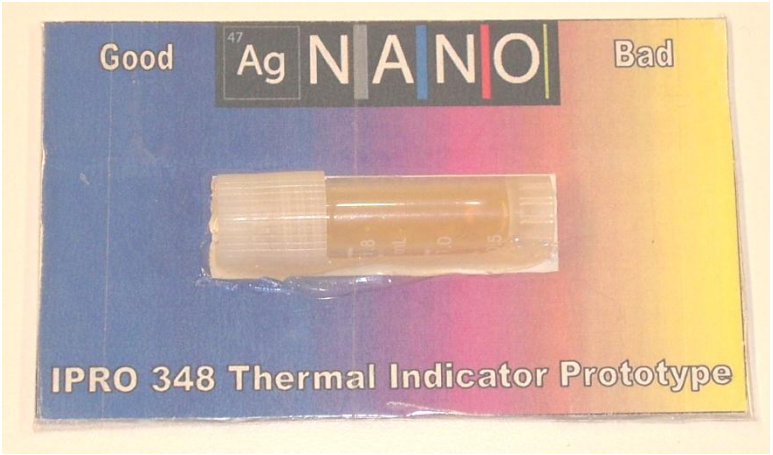
- New Technology
  - Other applications
  - Competitor research
- Ethical Considerations
  - Environment
  - Consumer



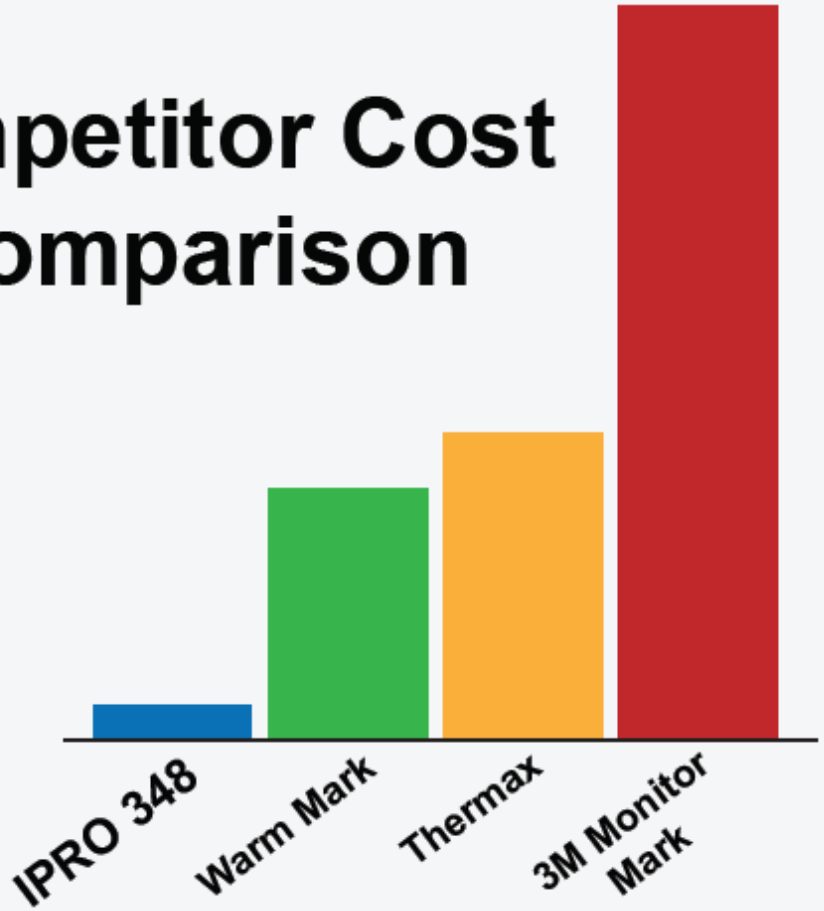
Prototype

- Design
  - Consumer
  - Manufacturer
  - Environment
- Packaging
  - Capsules
  - Gels
- Labels





Competitor Cost Comparison



Nanorod Label Cost

Total Cost: $0.25

Conclusions

- Possible to control quality, time and concentration properties
- Labels are competitive
  - Future applications
  - Increased production
  - Ethical considerations incorporated
- Quantitative quality control

Recommendations

- Continued lab research and scale-up design
- Improve label design
- Test toxicity and disposal
- Market research
- Improve viability of existing prototype

Acknowledgements

- Professor Perez-Luna
- IPRO Office