Quick Silver 47

IPRO 317

Silver Nanorods as Thermal Indicators

Agenda

- Project Introduction
- Background
- Team Organization
- Research & Development
- Laboratory Achievements
- Market Analysis
- Conclusion

Agenda

Project Introduction

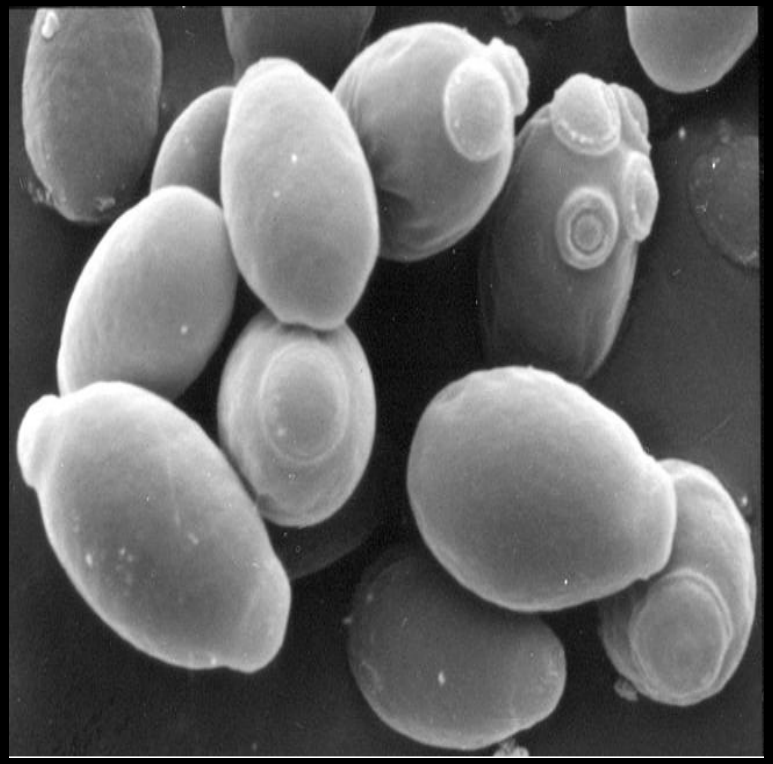
Project Introduction

- Incidence rate for food poisoning
  - **76 million cases** annually in USA

- Average yearly U.S. beef consumption
  - 28.1 billion pounds
  - $74 billion

- Food wasted (USDA)
  - 195 lb/capita/year
  - 33.7% red meat

  (Producer – Consumer)



http://www.micron.ac.uk/organisms/images/yeast4a.jpg

Objectives

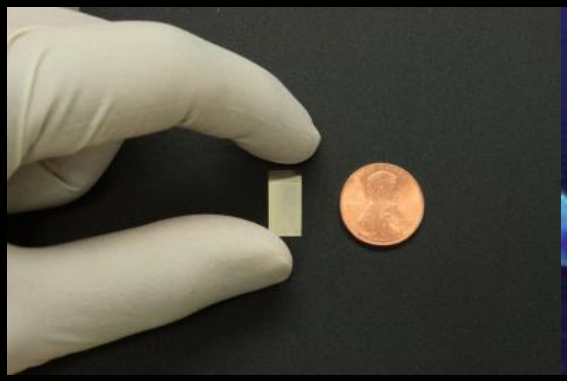
- Universal marketability
- Broader temperature range
- Improved efficiency in temperature monitoring
- Ethical concerns
  - Inconclusive health and environmental effects

Agenda

- Project Introduction
- Background

Background

- What are nanoparticles?

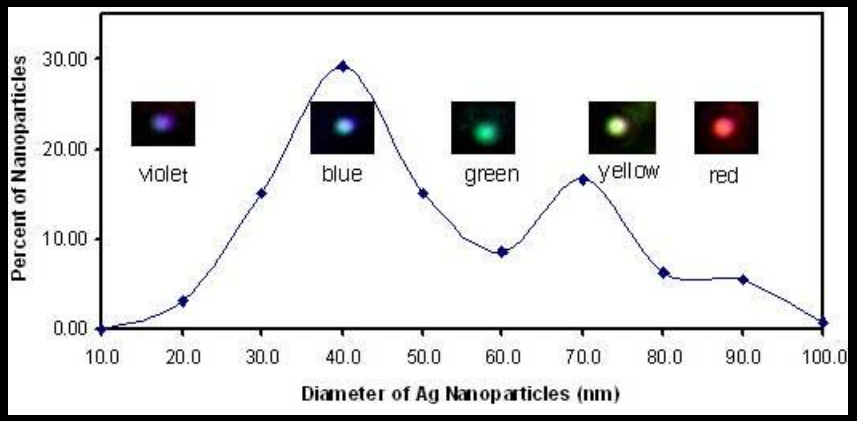


Source: University of Utah

Source: University of Missouri

- Nanorod-based thermal indicators

- Technology



Source: Nano World News by David Conrad

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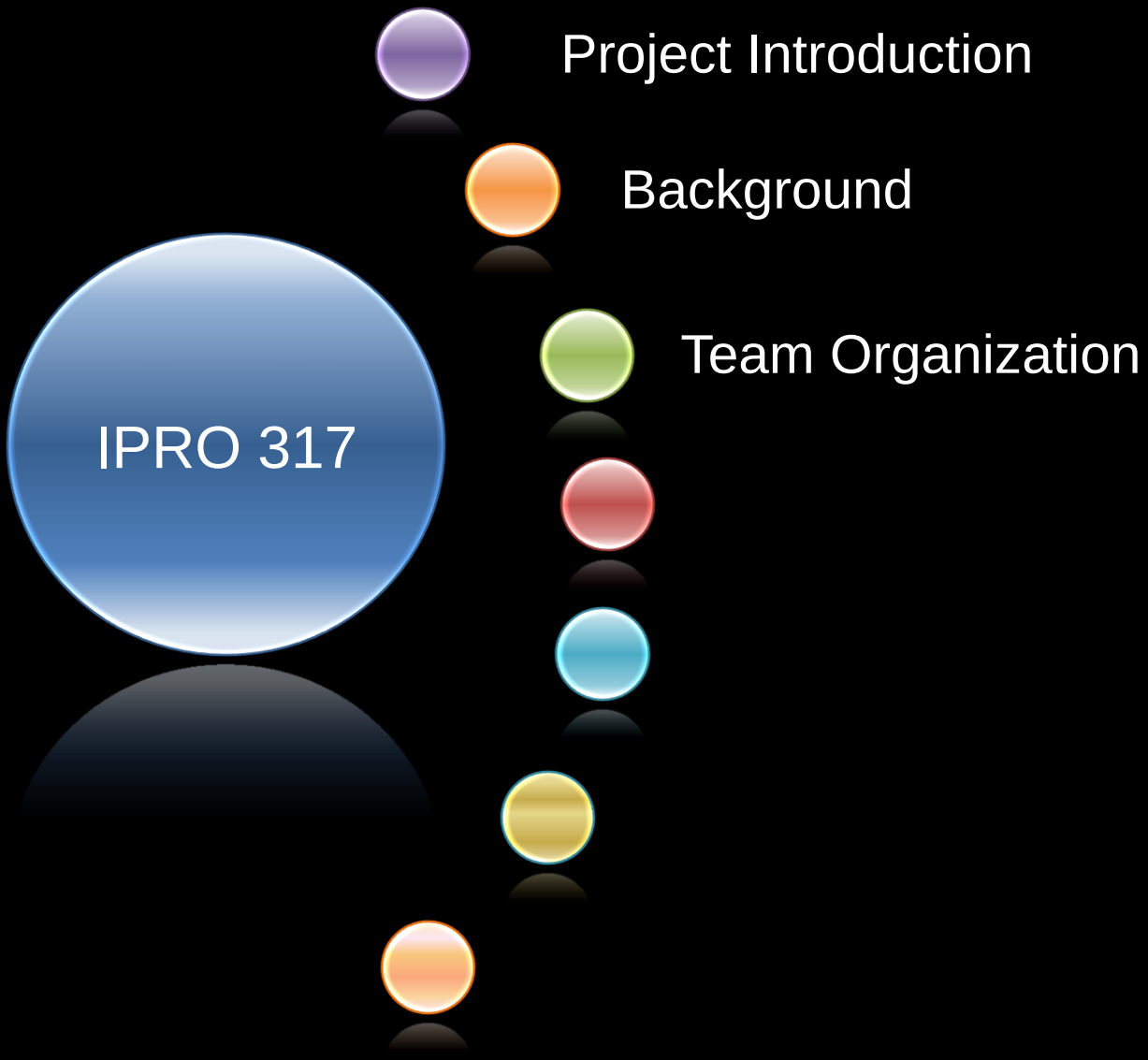
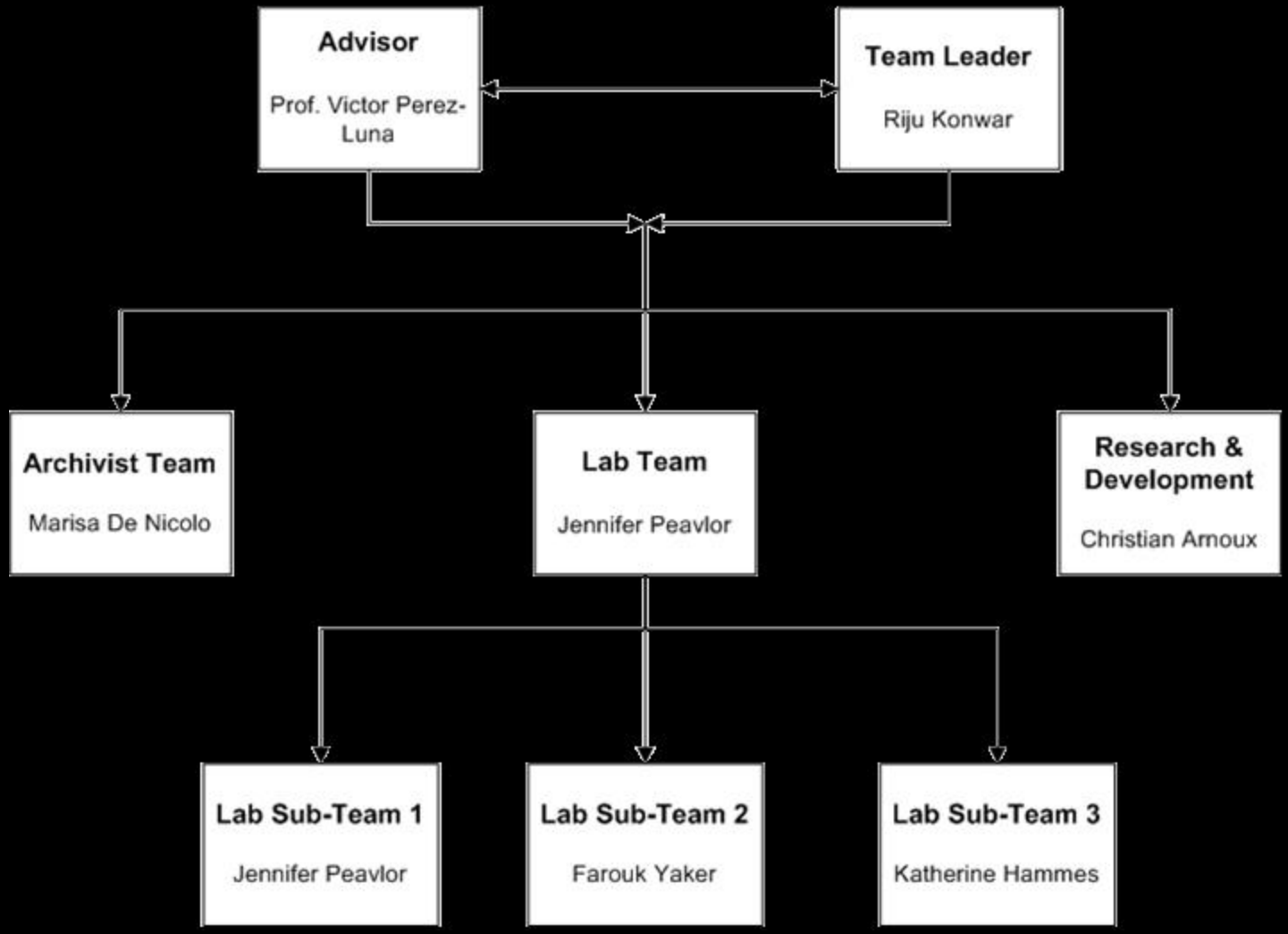
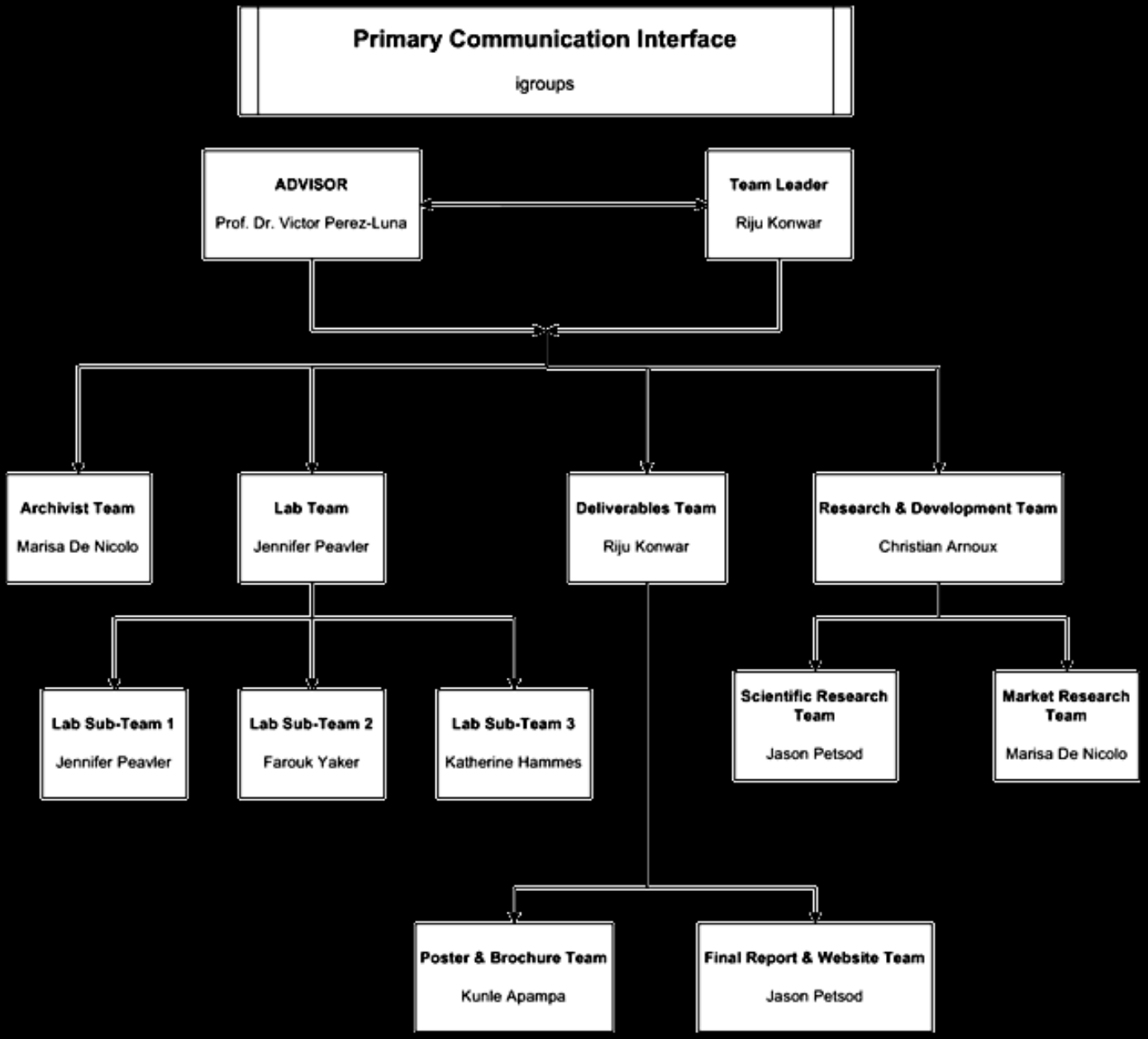


- Project Introduction
- Background
- Team Organization

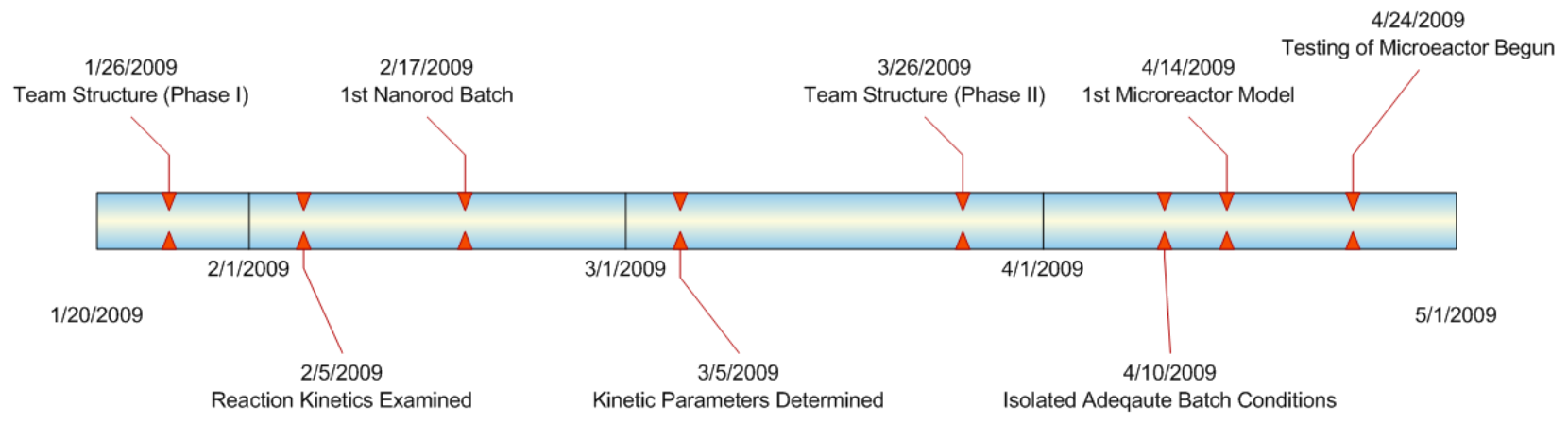
Team Organization (Initial)



Team Organization (Final)



Team Management



Challenges	Resolution	Impact
Communication	Igroups	Improved task efficiency
Monitoring Tasks	Ram chart	Individual performance improved
Deadlines	Gantt Chart	Time efficiency improved

Agenda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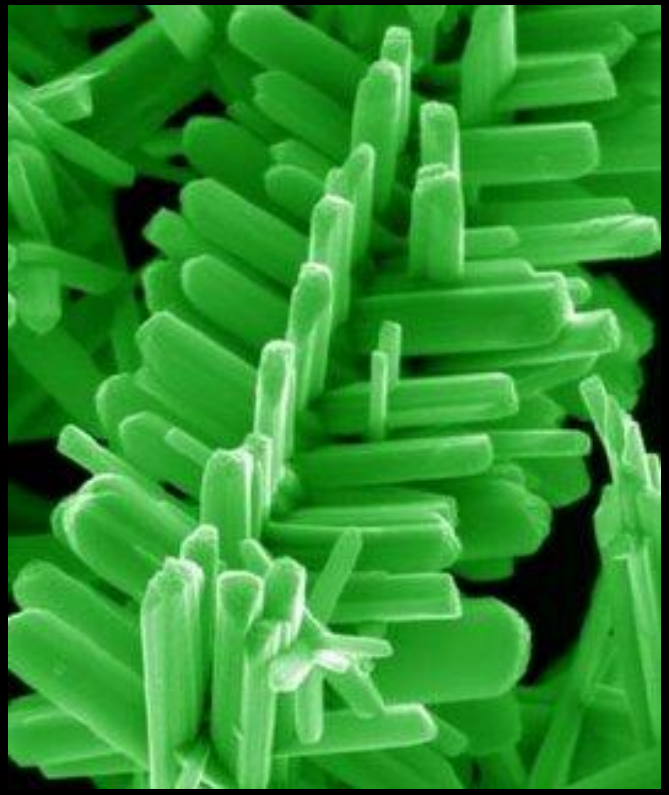
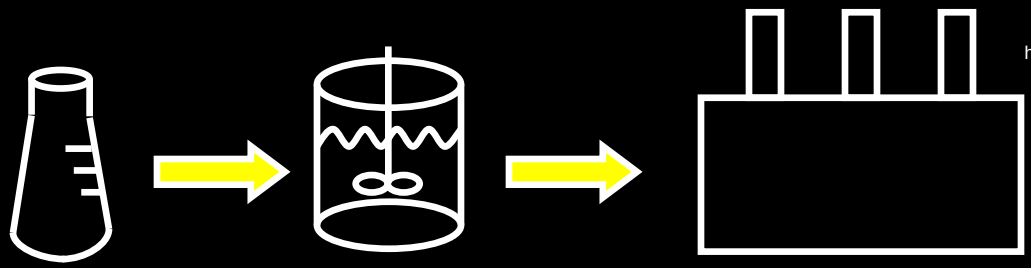
Project Introduction
Background
Team Organization
Research & Development

Research Team

- Research nanorod background
- Computer simulation
- Conduct kinetic experiments
- Scale-up to continuous process

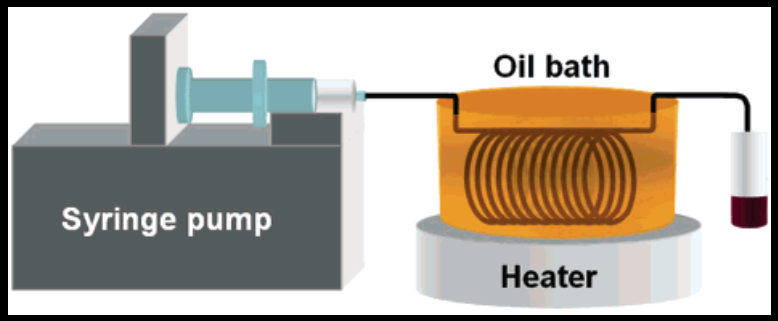


http://nanotechnologytoday.blogspot.com/2008/08/nanosculpture-could-enable-new-types-of.html



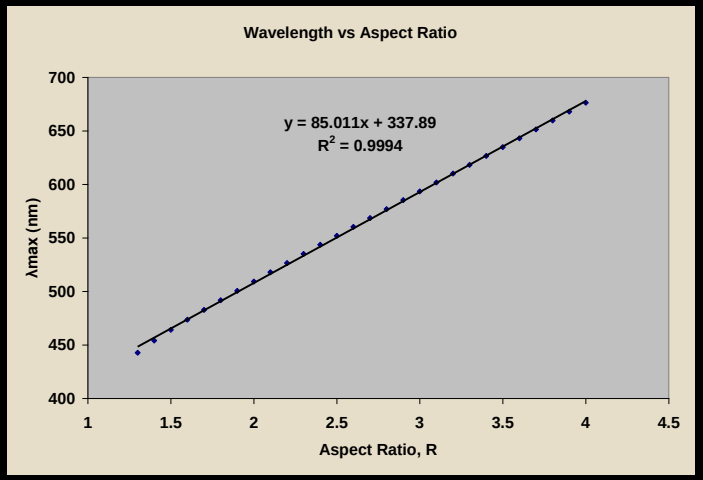
Continuous Flow Synthesis

- Microreactors most promising
- Control size distribution of particles
- Diffusion can be slow
  - Micromixers often used

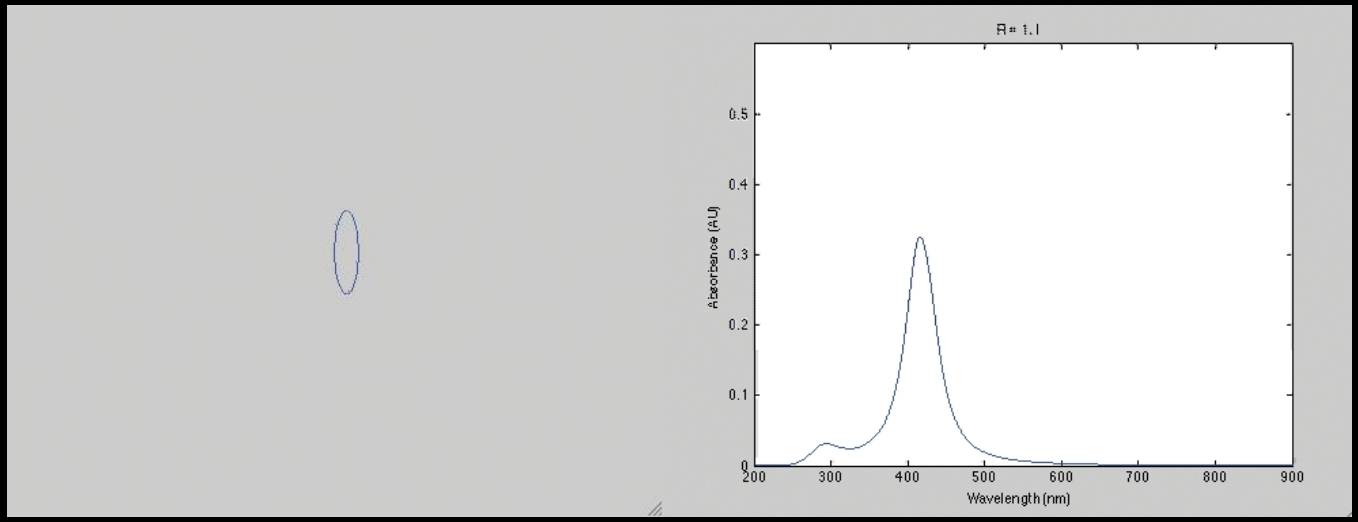


Lin, Xue Zhang, Alexander D. Terepka, and Hong Yang. Nano Letters 2004.

Computer Simulation

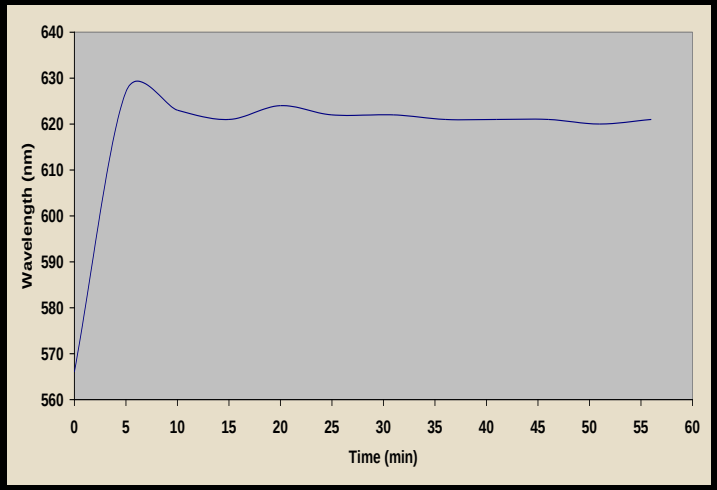


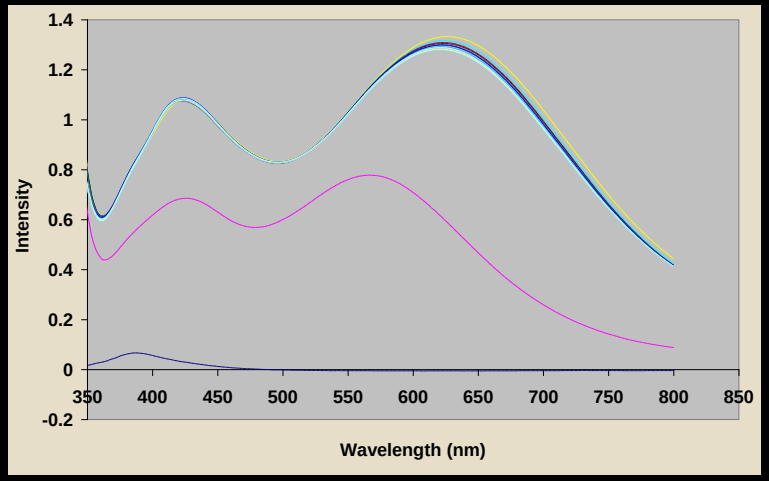
- Shape dependent optical properties
  - Spherical – 400nm peak
  - Rods – 600nm peak
- Provides correlation between wavelength and concentration



Kinetics

- Monitored the growth of nanorods over time
- Most growth achieved within 5 minutes





- More experiments needed to obtain reliability in results

Agenda


IPRO 317
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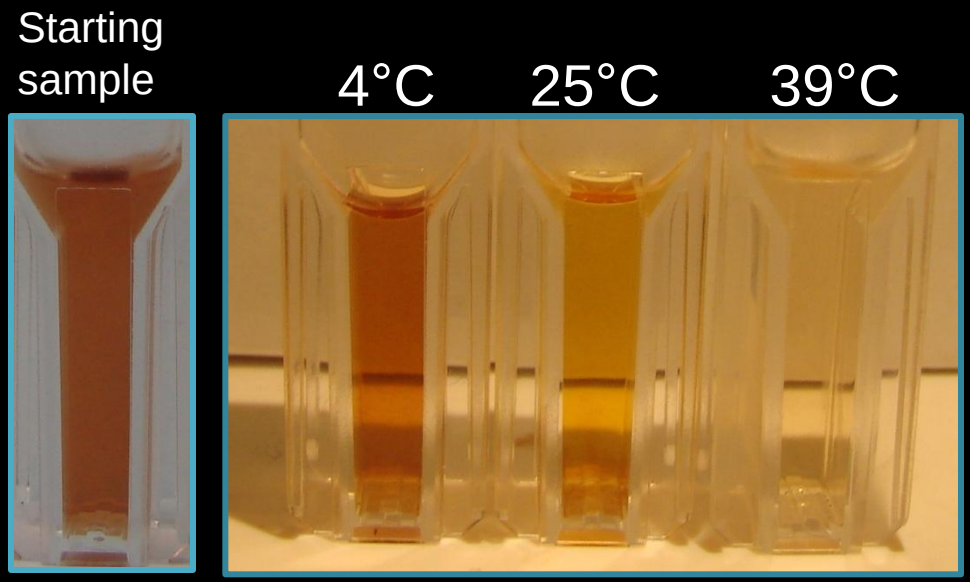
Laboratory Achievements

Laboratory Team

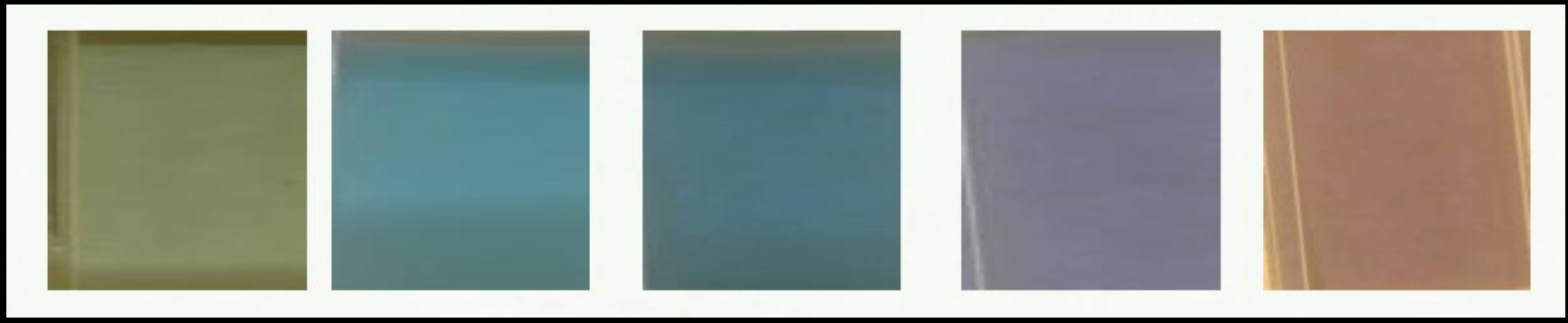
- Purpose
  - Can silver nanorods be used as thermal indicators?
- Experiments
  - Time dependent
  - Temperature dependent

Temperature dependent results

- Does temperature effect color?
- Stored at three temperatures
- Noticeable color change



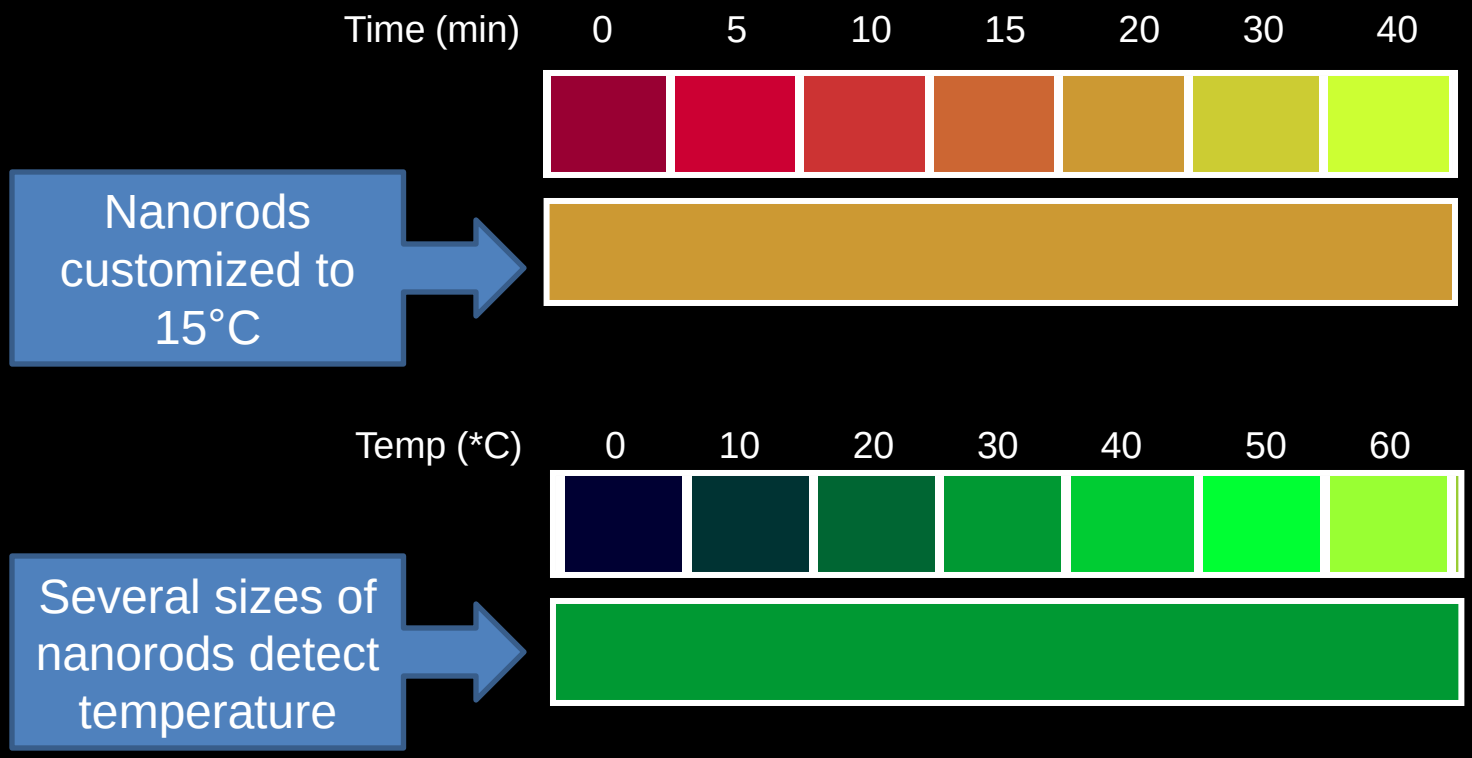
Time dependent results



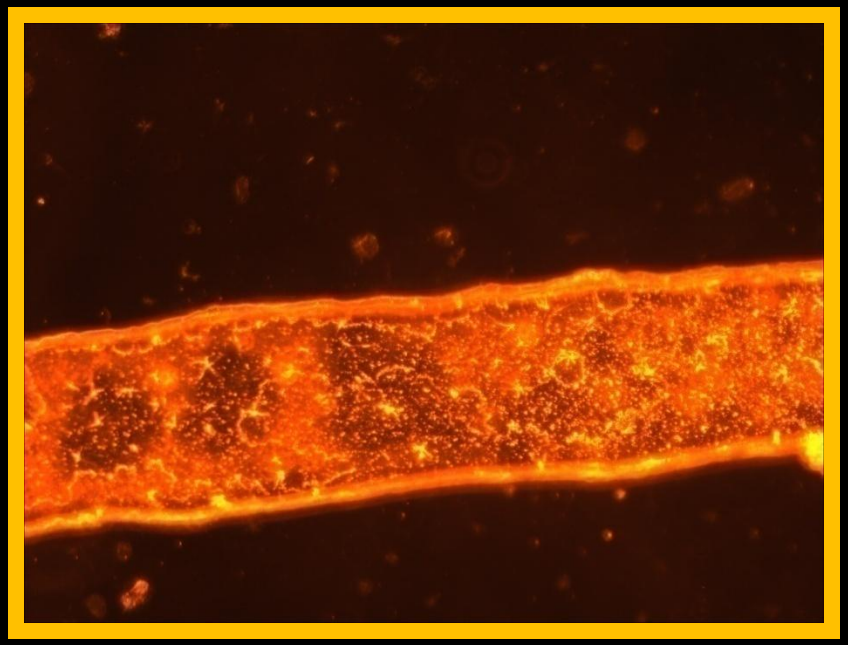
0 10 90 150 210 min

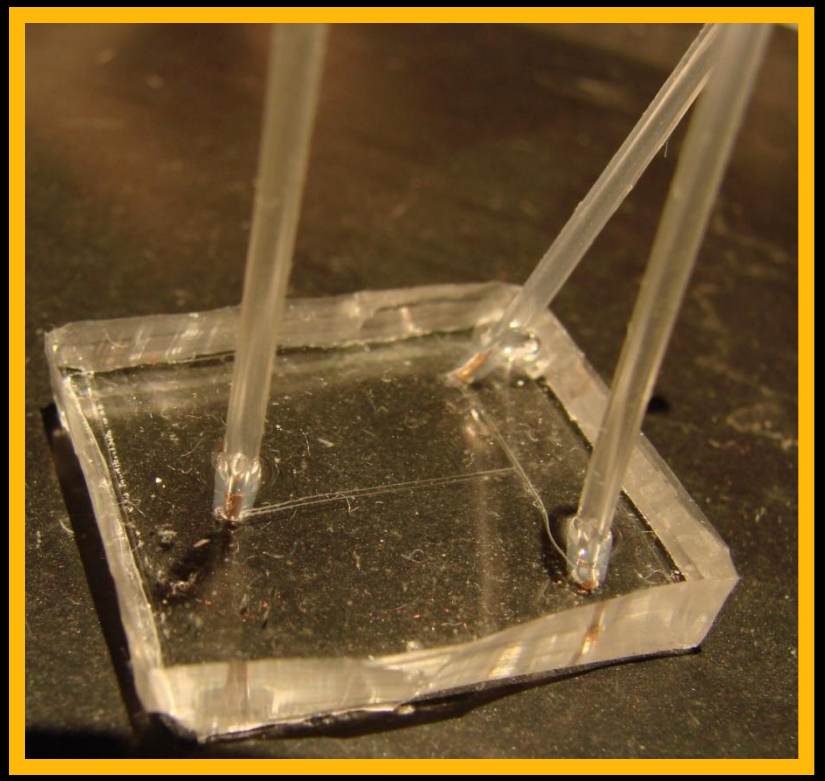
- Sample was submerged into a water bath
- Temperature was held at 55^{o}C
- Photographs were taken periodically

Prototype Label



Continuous Flow Microreactor





Batch to continuous process transition

Agenda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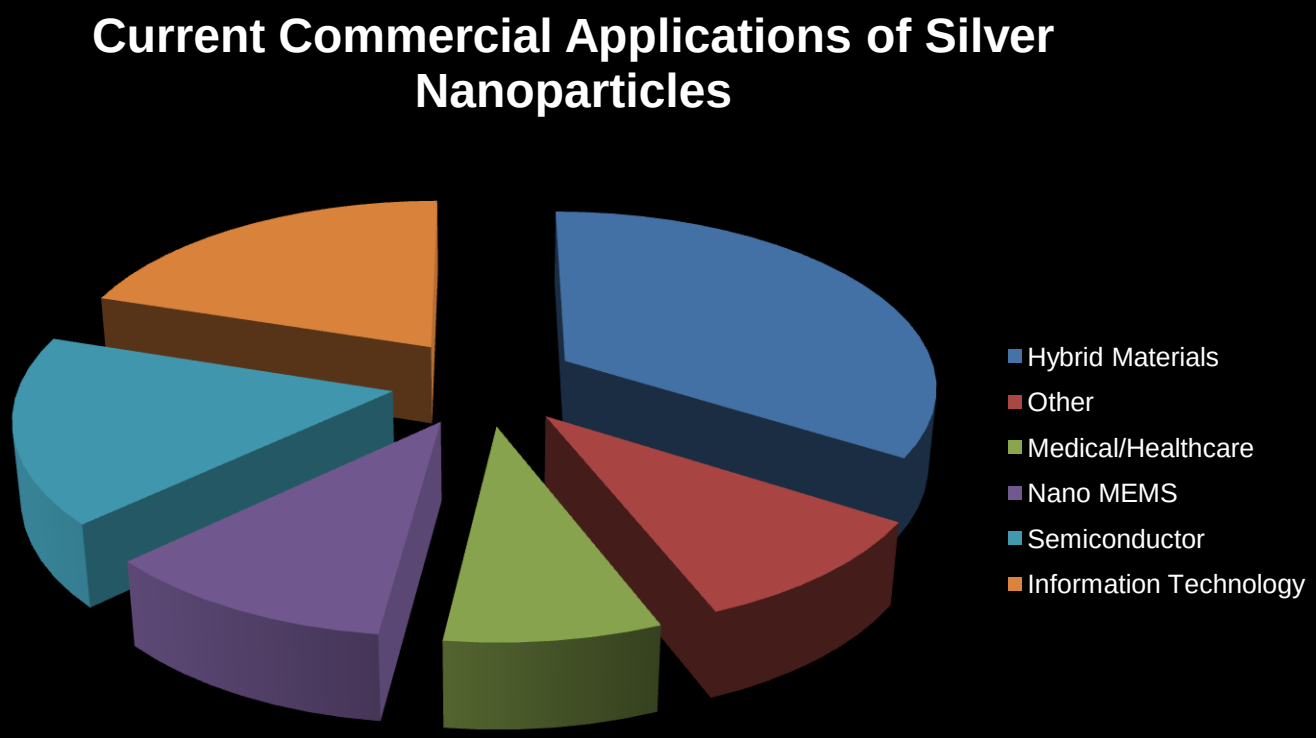
Market Analysis

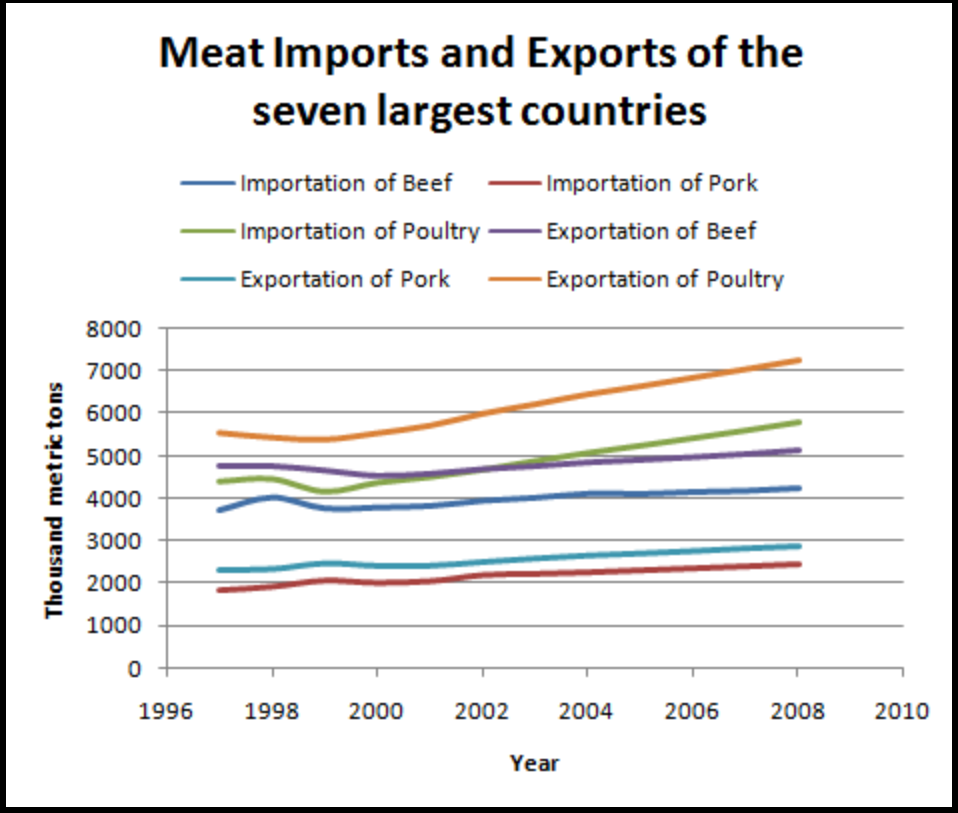


http://desma9fall07a.wordpress.com/2007/12/04/nanotech-adam-molinaro/

Market Analysis

Potential market for thermal indicators:

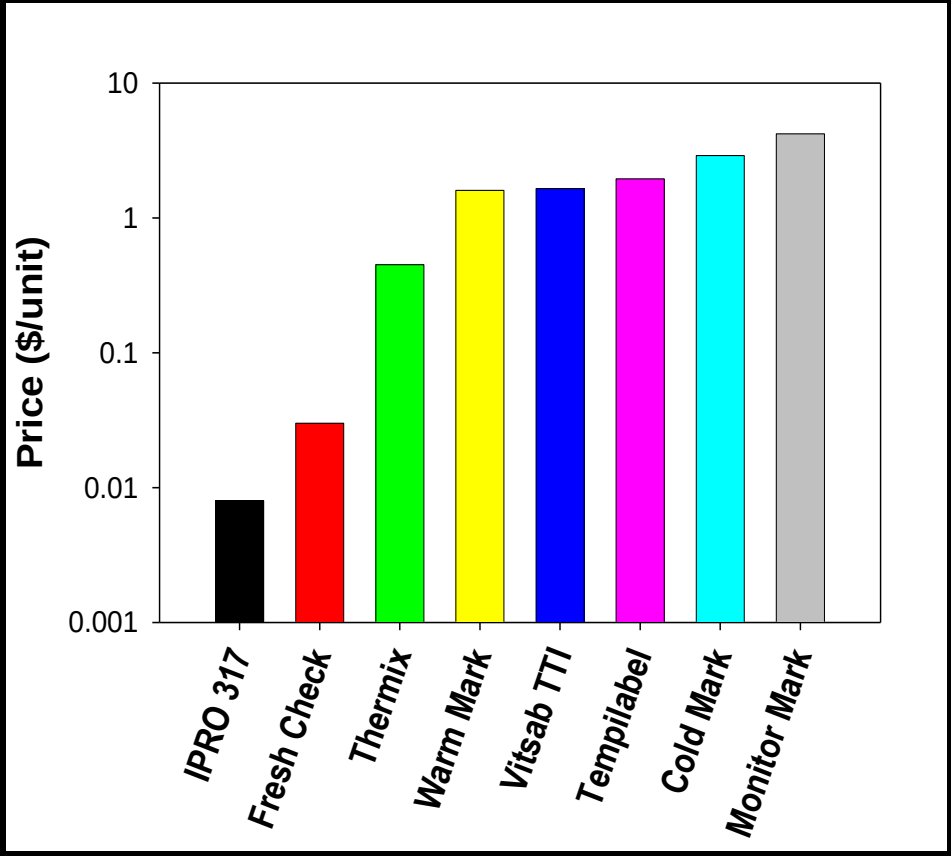
- Food
- Pharmaceutical drugs
- Electronics



Data from the US Department of Agriculture

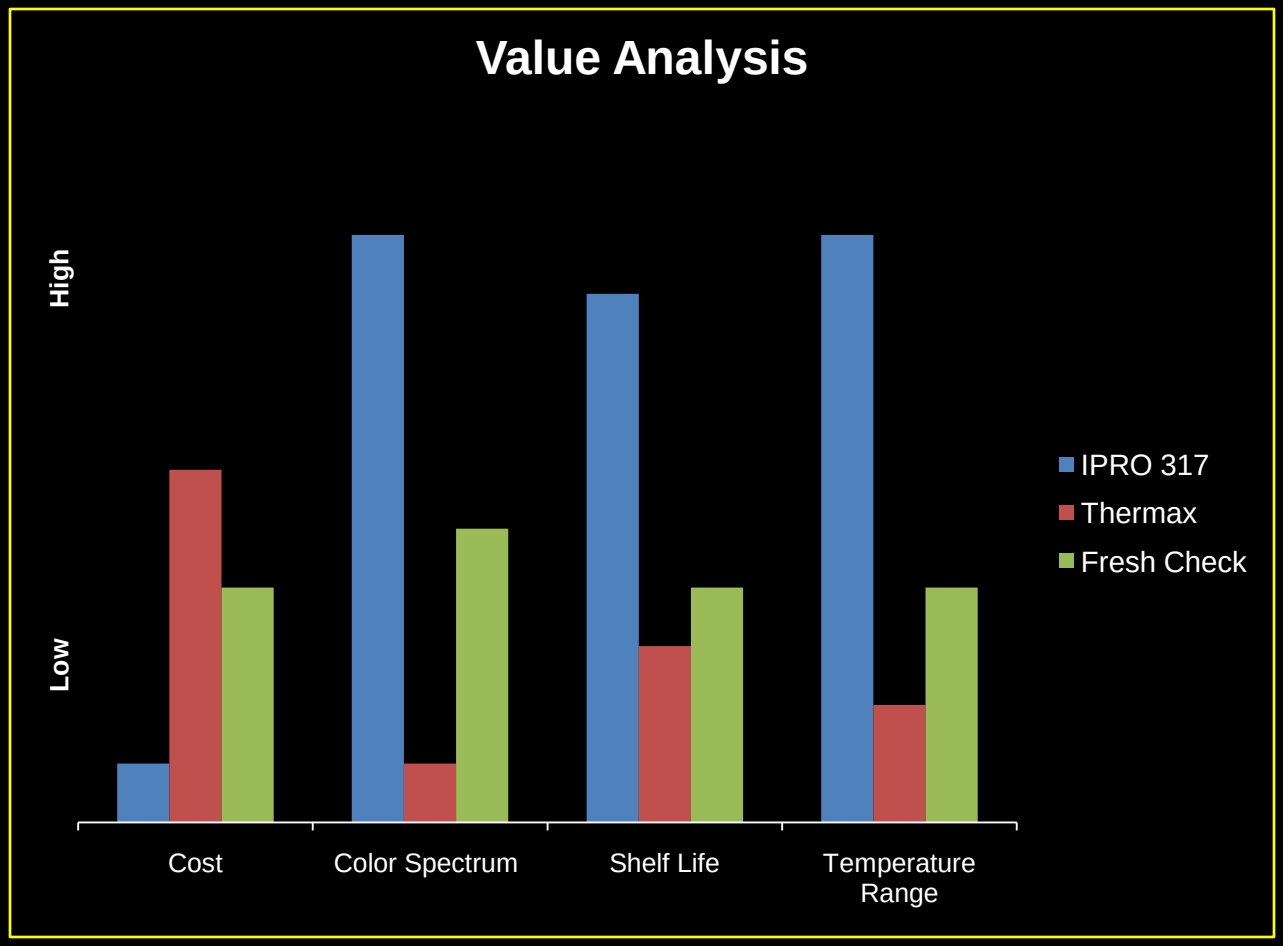
Economics

- 0.8 cents / label
- It is over 3 times cheaper than the closest competitor



The price is on a logarithmic scale of base 10

Competitive Advantage



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Conclusion

- Successful batch process produced
- Color spectrum validation
- Continuous flow process designed
- Testing in progress

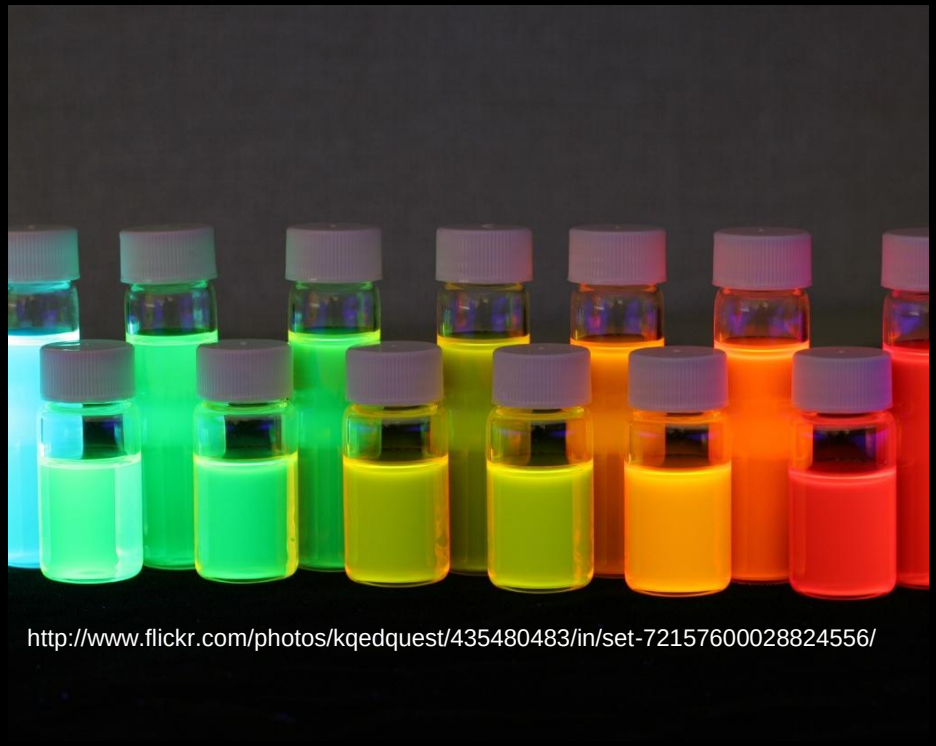
http://www.flickr.com/photos/48372717@N00/435479522

Future Work

- Further develop the microfluidics model
- Optimize reaction conditions
- Explore other possible markets
  - Surface Enhanced Raman Scattering (SERS)
  - Antimicrobial application (Healthcare)

http://nanotechnologytoday.blogspot.com/2007_04_01_archive.html

Questions?



http://www.flickr.com/photos/kqedquest/435480483/in/set-72157600028824556/

Hi Ho Silver!