

IPRO 348



Silver Nanorods as Indicators of Thermal History

How Silver Nanorods Can Prevent Foodborne Illness

PROBLEM

Foodborne illnesses in the US costs \$152 billion annually in health related expenses.¹

\$152
billion



A majority of those illnesses are from non-produce items², many of these are perishable products requiring stringent, low temperature storage conditions.

Foodborne illness is a major issue in the US and abroad. In 2003 there was a large outbreak in New York City after the major power outage³, and in 2004, hundreds of children in Kiev were hospitalized from drinking spoiled milk at summer camp.⁴

By creating nanorod label indicators, it is possible to determine if proper storage conditions have been maintained from production to consumption.

WHY SILVER NANORODS?



As nanorods heat up or age, their physical shape changes, resulting in a visual color change that can serve as an indicator of age and temperature.

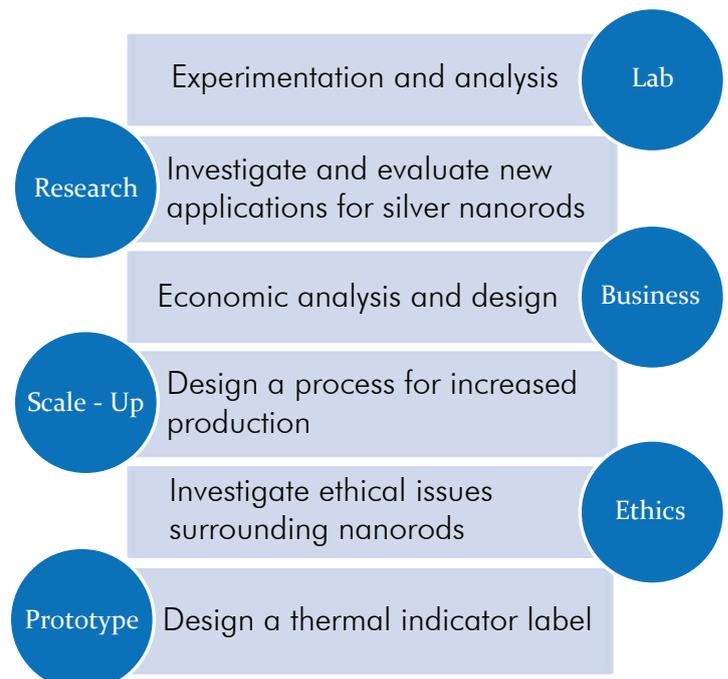
The Spring 2009 IPRO was able to achieve:

- Ideal nanorod volume
- Reduced cost estimate for nanorod label creation
- Promising thermal and time indications

OBJECTIVES

- Create silver nanorods with desired properties
- Compare to existing technology: cost, demand, practicality and environmental impact
- Investigate further potential for new applications such as virus detection
- Develop quantitative quality control
- Evaluate environmental, health and safety risks
- Design a process to scale-up production
- Create a prototype thermal history indicator
- Expose team to Chemical Engineering Design

METHODOLOGY

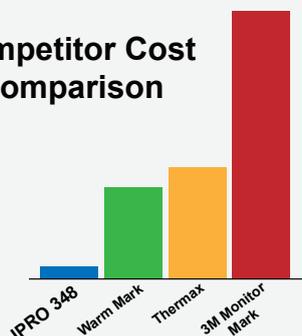


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RESULTS

Competitor Cost Comparison

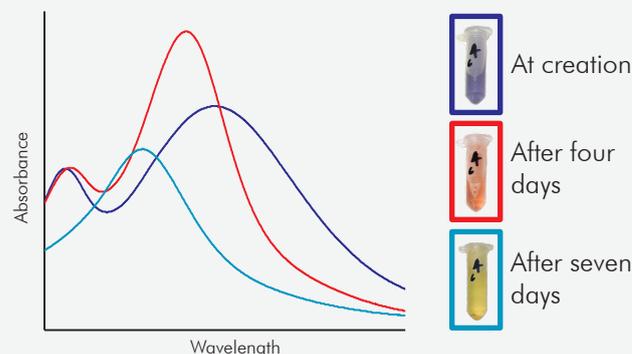


This figure depicts the raw material cost of the IPRO indicator compared with market price of our competitors.

Although this is only the raw material cost of our label, the technology

looks promising as it costs much less than our competitors. It also has the capability of a continuous spectrum color change rather than a single color change. In addition, most of the cost is in the label, not the nanorod material.

Silver Nanorod Analysis Using Spectroscopy



This graph shows a nanorod sample tested at three times: shortly after it was first mixed and centrifuged on the fourth day, and on the seventh day. The different peaks correspond to differences in physical shape.

Nanorod Label Cost



Total Cost: \$0.25

Silver Nitrate
Trisodium Citrate
Sodium Borohydride
Ascorbic Acid
Surfactant
Sodium Hydroxide

Obstacles Addressed

- Limited experimental data
- Incomplete protocols
- Varying lab conditions
- Team logistics and communication
- New technology research
- Packaging difficulties

CONCLUSIONS

It is possible to consistently make silver nanorods and control the quality, time, and concentration properties.

Nanorod labels are competitive in market applications:

- Additional applications
- Continuous production
- Ethical considerations incorporated

RECOMMENDATIONS

- Continue lab research and scale-up design
- Enhance label design
- Test toxicity and disposal
- Market research
- Improve existing prototype

References

1. Pew Charitable Trusts and Georgetown University, <http://www.reuters.com/article/idUSTRE6220NO20100303>
2. Centers for Disease Control, http://eatdrinkandbe.org/article/index.0331_fs_producereport
3. CNN.com, Monday, Aug 18th, "Spoiled Food Behind NYC Illness"
4. "Hundreds of children hospitalized in Ukraine's Capital," AP World Stream, March 21, 2004

Acknowledgements

Professor Victor Perez-Luna
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