PROJECT PLAN

IPRO 317

Silver Nanoparticles
Indicators of Thermal History

2/6/2009

Contents

1. Team Information

A. Team roster, team member strengths and team member expectations

Name	Year/Major	Contact Info	Specialty/Strengths	Expectations
Michael Schillaci	5th year CHBE	mschilla@iit.edu	Previous lab experience, (school and job labs)	Gain better overall understanding of nanoparticles and their practical uses
Marisa De Nicolo	4th yr MSE	mdenico@iit.edu 630-346-7479	Material lab experience, CS experiance	To gain a better understanding of the processing and uses of nanoparticles
Evan Larkin	4th yr CS	elarkin@iit.edu	Software development, linux systems, Windows systems computer networking.	The chance to apply my field (software engineering) to a real problem.
Katherine Hammes	4th yr ChE	khammes@gmail.com 913-908-0503	HYSIS and Matlab experience; have worked in a physics and a organic chemistry lab	To learn how to synthesize nanoparticles and to covert a batch process to a continuous flow process
Jennifer Peavler	4th yr CHBE	jpeavler@iit.edu (773)791-2412	Bionanotechnology. Lab experience. Good at designing powerpoint presentations.	Would like to arrive at a good microreactor design.
Amanda Wicker	4th yr CHBE	awicker@iit.edu 320-247-2388	prior lab experience with nanoparticles	Optimize nanorod synthesis, design microreactor
Christian Arnoux	4th yr CHBE	carnoux@iit.edu 847-840-0963	Chemical Engineering, General lab experience	To obtain a better understanding of nanorod synthesis while moving forward with microreactor design
Russell Ucci	4th yr CHBE	rucci@iit.edu 630-291-8190	HYSIS, Matlab, general lab experience, reactor design	Greater knowledge of the intricacies of nano-rod and reactor design
Grant Justice	4th year ME /MS	gjustice@iit.edu 312-523-6163	ME/MS lab experience, general understanding of microreactor fabrication	Learn more about the specifics of microreactor design and fabrication

Riju Konwar	4th Year CHE, BME, MMAE	rkonwar@iit.edu	Computational Fluid Mechanics, Bio-Reactors, Reaction Kinetics, MatLab, Solidworks and Engineering Contrast	To gain working knowledge of nanoparticles and hopefully to be able to design a functional engineering process.
Mark Pyciak	4th year CHBE	mpyciak@gmail.com 773-387-2099	Meticulous, well-organized and has experience in lab	At the very least I expect to gain an understanding of the specific problems associated with adapting the nanorod batch process to a continuous process.
Farouk Yaker	4th year CHBE	fyaker@gmail.com 773-286-7514	Proficient in Aspen, Icarus, Hysys. Lab experience.	To develop a good working model of the continuous process and win on IPRO day.
Muhammad Darwish	4th year CHBE	mdarwish03@gmail.com 8473610391	Bio and CHBE lab experience	Design and come up with a good project which improves this process
Jason Petsod	3rd yr physics	jpetsod@iit.edu 773-407-7024	physics, web sites/programming, LaTeX, spelling and grammar zealot	learn about AgNPs including some lab work
Malisa Ismail	3rd yr CHBE	mismail1@iit.edu 313-213-1763	Report format and editing. General lab experience, enforcing safety in the lab ☺ (PPE!)	To understand nanoparticle synthesis and its applications. To assist in designing flow synthesis process for Ag nanorods.
Remi Adejinle	3rd yr CHBE	radejinl@iit.edu 3127304212	General Chemistry lab experience. Can make power point slides	Hoping to gain an understanding of nanoparticles and help arrive at a better design suitable for large scale production
Ryan Kyle	3rd Year ChE	rkyle@iit.edu (312) 231-2834	Chemistry/Physics lab experience	To learn about the synthesis of nanoparticles
Kunle Apampa	3rd year ChE	aapampa@gmail.com (312) 841.2455	Researching & Lab experience	Expand my knowledge in nanotechnology.
Aram	2nd yr physics	aapyan@iit.edu	Physics, Math,	Learn about the

Apyan		847-688-3762	programming, lab and research experience	behavior of nanoparticles
Brent Bijonowski	2nd yr CHBE	bbijonow@iit.edu 312.835.6804	CS background, and lab experience	Learn about the production and implementation of silver nanoparticles
Paul Adamczyk	2nd yr CHBE	padamcz1@iit.edu 773-616-9409	General lab exp.	Achieve solid understanding of silver np's.
Joseph Muchna	2nd Year MSE	jmuchna@iit.edu 708-341-5424	Material Lab experience	Learn more about nanoparticles
Mathew Bednarz	2nd year CHE	mbednarz@iit.edu 630.220.1740	Some lab experience, previous research on nanowires	Learn about production of particles on the nano scale, gain experience with synthesis of particles
Amaka Mbaegbu	2nd year CHBE	ambaegbu@iit.edu (312)-498-4448	CS Background and Some Lab experience	Learn about the production and implementation of nanoparticles

B. Team Identity
- Name: Quick Silver 47
- Motto: Hi Ho Silver!
- Logo:

2. Team Purpose and Objectives

A. The primary purpose of IPRO 317 is to prove the merit of using silver nanorods as a thermal history indicator. The extended purpose of IPRO 317 is to convert the production of silver nanorods from a batch process to a continuous flow process.

B. To accomplish this our team will:
- Gain deeper understanding of batch process.
- Research continuous flow processes with an emphasis on microreactors

- Design and simulate a continuous flow process for production of silver nanorods with the aid of a computer simulation software.

3. Background

A. There is no sponsor for IPRO 317; however, we will be working closely with Professor Perez-Luna, and we will be using his laboratory facilities
B. Some difficulties that the user will be facing are the need to rely heavily upon instruments in order to obtain results and each batch process may produce different result based on small fluctuations.
C. Possible technologies and instruments that are involved in this project include nanotechnology, microreactors, a spectrophotometer, and a dark film microscope.
D. Silver nanorods are typically produced by a batch process with limited reproducibility. Currently research groups are investigating the possibility of a continuous flow process.
E. A few ethical issues considered within this IPRO are the negative environmental and health issues, the ensured safety of lab personnel, and upholding the ACS regulations for the safe handling and disposal of all chemical species utilized within the laboratory.
F. Success of converting the production of silver nanorods from a batch to a continuous flow process will save time and money.
G. The IPRO 317 team will focus on reproducing silver nanorods with the same aspect ratio through a batch process and thusly proving the merit of using silver nanorods as thermal history indicators. The next step will be to convert this process to a continuous flow process through the employment of a series of continuously stirred microreactors.
H. Thus far the attempt to find articles concerning the conversion of the production of silver nanorods from a batch process to a continuous flow process has been met with limited success. Several articles have been found indicating the feasibility of using silver nanorods as thermal history indicators.

4. Team Values Statement

A. Desired Behaviors

Every team member is expected to:

- Be respectful and curious to others.

- Be responsible, including fulfilling assigned tasks in a timely manner and arriving prepared and on time for meetings.
- Employ ethically and environmentally conscious practices.
- Maintain open communication lines with teammates through multiple mediums, including iGroups, email, and meetings.

B. Resolution of Problems

The following actions will be taken to address problems:

- Problems are to be communicated directly by the party concerned to the appropriate person, whether that person be another student, the team leader, or the IPRO adviser
- If the issue still remains, the problem will be presented to the entire IPRO team
- The resolution will be voted upon by the entire team

5. Methodology/Brainstorm/Work Breakdown Structure

A. The primary problem that IPRO 317 faces is to prove the merit of using silver nanorods as a thermal history indicator. A further problem that IPRO 317 wishes to address is the conversion of the production of silver nanorods from a batch process to a continuous flow process.
B. Our group plans to do the following to address this task:
   - Literature Research concerning the production of silver nanorods
   - Literature Research about processes employing the use of microreactors
   - Make silver nanorods in the lab through batch process to discover information about kinetics and thermodynamics of reactions.
   - Develop preliminary designs for a microreactor using information from experiments
   - Use computer software to optimize design
   - Build and test microreactor
C. Potential solutions will be tested by
   - Analyzing lab results
   - Designing and simulating microreactor with the aid of computer simulation software such as HYSYS
D. The task of documentation will be relegated to two individuals.

- One individual will be in charge of collecting, organizing, and compiling research regarding the production of AGNRs, information about microreactors, and any other literature research that arises.
- This individual will also be in charge of collecting, organizing and compiling any experimental data obtained from the lab.
    - This individual will work closely with the team leader to ensure that progress is being made.

E. The following actions will be taken in order to analyze results.
    - Results will be collected and organized by the team archivist. These results will be analyzed by the Junior and Senior members of the group.
    - The consensus of the analysis will be brought to the advising professor with the intent of gaining insight and direction.

F. The IPRO deliverable reports will be generated by a team whose main focus is to coordinate the events and results of the team with the IPRO office deliverables.
    - This team will work closely with the rest of the team in order to ensure that deliverables are generated in a timely manner.
    - The team leader will also work closely with the IPRO deliverable team in order to ensure optimal results.

6. Expected Results

A. The overall goals of IPRO 317 are to prove the feasibility of using silver nanorods as thermal indicators and to convert the production of silver nanorods from a batch process to a continuous flow process. For the scope of this semester, our team can realistically expect:
    - Extensive research on current silver nanorod production techniques.
    - Extensive research on microreactors or any other reactors which will enable the conversion between a batch process and a continuous flow process.
    - Several experiments involving batch production of silver nanorods.
    - A preliminary design and simulation of a microreactor.
    - A bench operation with a microreactor.

B. Our team expects to learn about the kinetic and thermodynamics of the laboratory batch process of making silver nanorods. This information is expected to be used when designing our microreactor.

C. Silver nanorods are becoming more widely used in industry. The continuous flow production of silver nanorods could be patented and sold to a number of companies employing the use of silver nanorods or any number of companies that currently produce silver nanorods.

D. Overall, the potential outcomes of this semester of IPRO 317 include successfully producing several batches of silver nanorods, designing a

microreactor, simulating a microreactor, and optimizing the microreactor design.

E. Mainly the expected result of this semester of IPRO 317 is to create an optimal microreactor design with the intent of converting the production of silver nanorods from a batch process to a continuous flow process.
F. The biggest challenge for this IPRO will be to convert laboratory results into meaningful data that will be incorporated into the design of a microreactor.
G. It is the intent of this IPRO team to develop and simulate an optimal design for a microreactor that will convert the production of silver nanorods from a batch process to a continuous flow process. Ideally, this design model will be used to aid future IPROs in actually building a microreactor.

7. Project Budget

The itemized quote for the following items is attached as an appendage to this report.

A. The following items are required for the production of silver nanorods:
    - CTAB
    - APTES
    - H_2SO_4
    - HCl
    - $AuCl_4$

8. Schedule of Tasks and Milestone Events

A. The following table lists significant project tasks

Milestones/Activities	Start Date	Completion Date	Hours Needed	# Team Members
Definition of Project Objectives	27-Jan-09	30-Jan-09	5	24
Gathering Research/Background	27-Jan-09	19-Feb-09	44	9
Lab Synthesis of Silver Nanorods	10-Feb-09	1-May-09	160	15
Analysis of First Lab Synthesis*	12-Feb-09	17-Feb-09	10	15
Design of Microreactor	19-Mar-09	16-Apr-09	52	9
Construction of Microreactor	16-Apr-09	16-Apr-09	6	5
Trial Runs of Microreactor	16-Apr-09	23-Apr-09	30	15
Preparation for IPRO Day	23-Apr-09	30-Apr-09	20	24

*Several batches of silver nanorods will be produced in the laboratory throughout the semester. Analysis and dates of analysis of lab results will be dependent upon the successful production of silver nanorods.

B. The following table lists all the tasks pertaining to IPRO deliverables

Milestones/Activities	Due Date	Hours	# Members
Project Plan	6-Feb-09	10	4
Midterm Review	2-Mar-09	10	4
Abstract/Brochure	27-Apr-09	10	4
Poster	27-Apr-09	10	4
Website/Meeting Minutes	27-Apr-09	160	3
Final Oral Presentation	29-Apr-09	30	15
Final Report	8-May-09	50	8
CD/TOC	11-May-09	4	2

C. To complete the aforementioned tasks and milestones the following skills or educational background will be required:
   - Technical skills involved in operating a dark film microscope, a spectrophotometer, and other essential laboratory equipment
   - Laboratory safety procedures
   - Familiarity with engineering software
   - A basic understanding of chemical reaction engineering

D. An estimate of hours needed and number of team members needed to complete each task are given in the previous tables. The total estimated number of man-hours to complete the aforementioned tasks is 611 hours.

E. Allotting 10 hours for slack time brings the total estimation of hours to 621 hours.

9. Individual Team Member Assignments

Name	Tasks
IPRO 317	The primary purpose of IPRO 317 is to prove the merit of using silver nanorods as a thermal history indicator. The extended purpose of IPRO 317 is to convert the production of silver nanorods from a batch process to a continuous flow process.
Konwar, Riju – Team Leader	Oversee all tasks, run meetings at which the entire IPRO is present, be the link between the professor and subgroups
De Nicolo, Marisa - Archivist	Compile research, collect lab results, keep everyone on task, take meeting minutes, organize iGroups folders
Subgroup: Research	Literature research pertaining to the IPRO; future subdivisons may include economics, microreactors, future applications, alternate synthetic procedures, etc
Arnoux, Christian – Group Leader	Manage and delegate tasks to the other members of the group and direct research efforts

Adamczyk, Paul	Dutifully carry out the research assigned by the group leader and present and/or post useful findings
Apampa, Ayokunle	
Apyan, Aram	
Justice, Grant G	
Larkin, Evan	
Muchna, Joseph	
Petsod, Jason	
Subgroup: Lab	Synthesize nanorods in a wet laboratory following previously published batch procedures
Peavler, Jennifer – Group Leader	Oversee and direct laboratory work, communicating what is to be done and organize group into shifts with assigned tasks
Adejinle, Remi	Actively participate in lab work and perform any additional research that may present itself as necessary over time
Bednarz, Mathew	
Bijonowski, Brent	
Darwish, Muhammad	
Hammes, Katherine	
Ismail, Malisa	
Konwar, Riju	
Mbaegbu, Amaka	
Pyciak, Mark	
Schillaci, Michael	
Ucci, Russel	
Wicker, Amanda	
Yaker, Farouk	

10. Designation of Roles

A. Meeting Roles

- **Minute Taker:** records decisions made during meetings, including task assignments or changes under consideration. – Marisa De Nicolo
- **Agenda Maker**: creates an agenda for each team meeting, which provides structure to the meetings and offers a productive environment. – Riju Konwar
- **Time Keeper:** is responsible for making sure meetings go according to the agenda. – Riju Konwar

B. Status Roles

- **Weekly timesheet collector/summarizer:** responsible for collecting weekly timesheets from each member of the team and updating everyone with a summary report. – Marisa De Nicolo
- **Master schedule maker:** responsible for collecting schedules from all the team members and developing a master schedule, which tells the team when members are available and how to contact them. – Farouk Yaker
- **iGroups:** responsible for organizing the team's iGroups account and ensuring that it is used properly. – Marisa De Nicolo

Appendix

PROFORMA INVOICE/QUOTATION

SOLD-TO:
ILLINOIS INST OF TECHNOLOGY
ACCOUNTS PAYABLE 201MB
3300 S FEDERAL
CHICAGO IL 60616

SHIP-TO:
ILLINOIS INSTITUTE OF TECHNOLOGY
10 W 32ND ST
CHICAGO IL 60616

CONTACT: JENNIFER
TELEPHONE: 7737912412
FAX: NOT AVAILABLE

SIGMA-ALDRICH

INQUIRIES TO:
SIGMA-ALDRICH INC
3050 SPRUCE ST
SAINT LOUIS MO 63103 US

Phone: 800-325-3010
Fax: 800-325-5052

PROFORMA INVOICE/QUOTATION #
21093611
DATE
02/04/2009
VALID UNTIL
05/04/2009
SOLD TO CUSTOMER NUMBER
49440651
CUSTOMER REFERENCE NUMBER
QUOTE DKB
INCO TERMS
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LINE	MATERIAL NUMBER	DESCRIPTION	QUANTITY	UOM	UNIT PRICE	EXTENDED PRICE	PROPOSED ROUTE
001	440140-100ML	3-AMINOPROPYLTRIETHOXYSILANE, 99% HAZ UN2735	1.00	EA	47.20	47.20	FEDEX GROUND Shipped From MILWAUKEE
002	G4022-1G	GOLD CHLORIDE TRIHYDRATE ACS REAGENT HAZ UN3260	1.00	EA	76.80	76.80	FEDEX GROUND Shipped From SAINT LOUIS
003	320331-2.5L	HYDROCHLORIC ACID, 37%, A.C.S. REAGENT (POLY-COATED BOTTLES) HAZ UN1789	1.00	EA	86.90	86.90	FEDEX GROUND Shipped From MILWAUKEE
004	84720-2.5L	SULFURIC ACID 95-97%, PE BOTTLE HAZ UN1830	1.00	EA	74.10	74.10	FEDEX GROUND

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CHICAGO IL 60616

CONTACT: JENNIFER
TELEPHONE: 7737912412
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SIGMA-ALDRICH

INQUIRIES TO:
SIGMA-ALDRICH INC
3050 SPRUCE ST
SAINT LOUIS MO 63103 US

Phone: 800-325-3010
Fax: 800-325-5052

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21093611
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CUSTOMER REFERENCE NUMBER
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LINE	MATERIAL NUMBER	DESCRIPTION	QUANTITY	UOM	UNIT PRICE	EXTENDED PRICE	PROPOSED ROUTE
							Shipped From Allentown
005	H9151-100G	HEXADECYLTRIMETHYLAMMONIUM BROMIDE, SIGMA ULTRA NON-HAZ UN3077	1.00	EA	88.70	88.70	FEDEX GROUND
							Shipped From SAINT LOUIS
							Items Total 373.70 USD Trans / Handling 124.70 USD Total Due 498.40 USD
			DSPROCKSH				