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NUE: Nano Science And Laboratory Experience (ScALE) at UMaine

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Preview of Award 1138214 - Final Project Report

[Cover](#) |
[Accomplishments](#) |
[Products](#) |
[Participants/Organizations](#) |
[Impacts](#) |
[Changes/Problems](#)

Cover

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|---|--|
| Federal Agency and Organization Element to Which Report is Submitted: | 4900 |
| Federal Grant or Other Identifying Number Assigned by Agency: | 1138214 |
| Project Title: | NUE: Nano Science And Laboratory Experience (ScALE) at UMaine |
| PD/PI Name: | Rosemary L Smith, Principal Investigator Scott D Collins, Co-Principal Investigator Michael D Mason, Co-Principal Investigator |
| Recipient Organization: | University of Maine |
| Project/Grant Period: | 01/01/2012 - 12/31/2014 |
| Reporting Period: | 01/01/2014 - 12/31/2014 |
| Submitting Official (if other than PD\PI): | Rosemary L Smith Principal Investigator |
| Submission Date: | 03/05/2015 |
| Signature of Submitting Official (signature shall be submitted in accordance with agency specific instructions) | Rosemary L Smith |

Accomplishments

* What are the major goals of the project?

One of the goals of this project is to introduce nanoscale concepts to first year engineering students at UMaine, through presentations, demonstrations and laboratory experiences. The other major goals are a) to enhance the

participation of engineering undergraduates at UMaine in nanoscale research activities, b) to develop and offer a new, upper division course on Nanoscience and c) to introduce a new minor in Nanotechnology.

*** What was accomplished under these goals (you must provide information for at least one of the 4 categories below)?**

Major Activities:

A new minor in Nanotechnology was created and approved by the University of Maine in 2013. During this reporting period (2014), 10 students enrolled in the minor. Three students are scheduled to complete the Nanotechnology Minor when they graduate in May 2015.

A new upper division course, entitled Nanoscience, was developed as a result of this project. It is cross-listed in the UMaine catalog as CHY 477 (Chemistry) and ECE 467 (Electrical & Computer Engineering). The course has been taught four times. Last Spring's class (Spring 2014) had an enrollment of twelve students.

The lower division course, GEE 298 - Introduction to Nanotechnology, was taught in Fall 2014 by PI Smith, to 8 undergraduate engineering students. This 3 credit course includes one ethics credit which is earned by students participation in classroom discussions, lectures, reading assignments, and a term paper that includes a discussion of the social and ethical implications of a particular nanotechnology that they chose to investigate. Of the 8 student participants, 4 enrolled in the Nanotechnology Minor, and 3 went on to participate in laboratory research.

Twenty seven (27) undergraduates participated in nanotechnology related research, outreach activities and/or nanotechnology instrumentation instruction during 2014, under the supervision of the PI and co-PIs. Two undergraduates transitioned to graduate school, and became graduate research assistants in the laboratory of co-PI Mason during this project period. In total, five graduate students participated in the project by supervising undergraduates, and assisting in instruction or outreach.

Numerous outreach activities took place during 2014, including visits to middle and elementary schools by PI Smith and co-PI Mason to work with teachers, tours of the nanofabrication facilities by Smith and Collins, and the development and delivery of activities for various visiting groups and organizations, including 4H, schools, Girls Engineering Maine, and Consider Engineering. Co-PI Mason developed hands-on activities and demonstrations for the Maine Engineering Expo, in March 2014, attended by >600 students in K-12 grades from all over the State of Maine.

Specific Objectives:

Increasing knowledge of and participation in research about nanotechnology was a specific objective, which was met by the presentation of introductory lectures, demonstrations and/or lab exercises in the first year curriculum of all engineering majors.

Significant Results:

More than 250 1st year engineering students participated in the module lectures/lab exercises in 2014. For the Electrical & Computer Engineering majors, PI Smith prepared and delivered two seminars to 47 first year students, introducing Nanotechnology concepts, the Nanotechnology Minor, and relevant research activities on campus. For the Chemical & Biological Engineering majors, co-PI Mason developed both a lecture and a hands-on laboratory experience with nanoparticle synthesis and characterization for 89 first year students enrolled in CHB 112 - Introduction to Chemical Engineering and Bioengineering. For Civil Engineering majors, PI Smith organized and coordinated with the instructor (Prof. Eric Landis) of CIE 110- Materials, the delivery of a lecture by Prof. Douglas

Gardner in Forestry, on Nanocomposites to 124 first year civil engineering students.

Key outcomes or Other achievements: The interest in nanotechnology was peaked in dozens of undergraduate students by the introductory modules, evidenced by the enrollment of 12 students in the new upper division Nanoscience course, 10 students declaring a nanotechnology minor, and the >20 engineering undergraduates who sought out research opportunities in nanotechnology on campus.

*** What opportunities for training and professional development has the project provided?**

As a direct result of this project, twenty-seven undergraduates participated in nanotechnology research at UMaine in 2014. Five graduate students participated in the supervision of undergraduate research and instruction, which provided them with mentoring and teaching experience.

*** How have the results been disseminated to communities of interest?**

In April, 2014, PI Smith gave a presentation about nanotechnology, demonstrated a portable Atomic Force microscope, and led a hands on activity with teens and their parents in Dexter, Maine - a rural school district. The event was organized by the Teen Science Cafe for ME.

PI Smith organized a "nanoparticle day" with middle school science teacher, Patricia Bernhardt, in Bangor. They developed a lab exercise involving TiO₂ nanoparticles for Mrs. Bernhardt's seventh grade science class. PI Smith spent a day at the middle school to introduce and assist in the laboratory exercise. PI Smith spoke to the students (5 classes, 15-24 students in each) about nanotechnology, its potential benefits to our lives and society, and the importance for scientists and engineers to study the impact of technological advances on the environment.

PI Smith led a nanotechnology hands-on activity with 20 4H members, ages 8-16 yrs of age, at UMaine on May 17, 2014. She gave them a presentation, introducing basic concepts, e.g. scaling, and the observed effects when nanoscale structures interact with visible light, and several demonstrations to illustrate, including the AFM imaging of a DVD. The hands on activities included making thin iridescent films using nail polish.

In April 2014, co-PI Mason visited the Orrington Center Drive School (K-8) where he and two graduate students led science discussions with 58 1st grade students with a nanotechnology theme, developed and supervised hands on activities and demonstrations alongside three 1st grade teachers.

Products

Books

Book Chapters

Co, A; Sitarski, A.M.; Grant, J.; Mason, M.D. (2015). Radiologically Imageable Nanoparticles. *Imaging and Visualization in the Modern Operating Room: A Comprehensive Guide for Physicians*. Status = AWAITING_PUBLICATION; Acknowledgement of Federal Support = No ; Peer Reviewed = No

Conference Papers and Presentations

Stuart Lawson, Joshua Wright and Robert Meulenberg (2014). *Field Directed Ordering in Magnetic Nanocrystal Structures*. American Physical Society March Meeting 2014 Session F3: Undergraduate Research - Society of Physics Students IV. Denver, Colorado. Status = PUBLISHED; Acknowledgement of Federal Support = Yes

Inventions

Journals

Kandpal, S.K., Co, A., Allcroft, K., Neivandt, D.J., Bousfield, and D.W., Mason, M.D. (2014). Laser-induced fluorescent micro-structures in silver nanoparticle based films. *Optical Materials*. 36 (5), 873. Status = PUBLISHED;

Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: [10.1016/j.optmat.2013.12.011](https://doi.org/10.1016/j.optmat.2013.12.011)

Kandpal, S.K., Otterson, S.L., Bousfield, D.W., Neivandt, D.J., Mason, M.D. (2015). Investigation of Laser Induced Structure formation and resultant fluorescence. *Optical Materials*. . Status = AWAITING_PUBLICATION; Acknowledgment of Federal Support = No ; Peer Reviewed = Yes ; DOI: [10.1016/j.optmat.2014.12.043](https://doi.org/10.1016/j.optmat.2014.12.043)

Licenses

Other Products

Other Publications

Patents

Technologies or Techniques

Thesis/Dissertations

Websites

Participants/Organizations

Research Experience for Undergraduates (REU) funding

Form of REU funding support: REU supplement

How many REU applications were received during this reporting period? Nothing to Report

How many REU applicants were selected and agreed to participate during this reporting period? Nothing to Report

REU Comments: REU support for this project was received as a supplement, in years 1 and 2. No REU support was received for the no cost extension period.

What individuals have worked on the project?

| Name | Most Senior Project Role | Nearest Person Month Worked |
|-----------------|--------------------------|-----------------------------|
| Smith, Rosemary | PD/PI | 3 |
| Collins, Scott | Co PD/PI | 3 |

| | | |
|----------------------|---------------------------------------|---|
| Mason, Michael | Co PD/PI | 2 |
| Millis, Justin | Other Professional | 2 |
| Co, Aileen | Graduate Student (research assistant) | 3 |
| Demers, Christopher | Graduate Student (research assistant) | 1 |
| Grant, Jeremy | Graduate Student (research assistant) | 3 |
| Holomakoff, David | Graduate Student (research assistant) | 3 |
| Sitarski, Anna | Graduate Student (research assistant) | 2 |
| Alley, James | Undergraduate Student | 1 |
| Bate, Keegan | Undergraduate Student | 2 |
| Beauchemin, Michelle | Undergraduate Student | 1 |
| Closson, Andrew | Undergraduate Student | 1 |
| Co, Aimee | Undergraduate Student | 2 |
| Fichter, Casey | Undergraduate Student | 1 |
| Fratto, Edward | Undergraduate Student | 3 |
| Fuhrer, Joshua | Undergraduate Student | 3 |
| Kashkooli, Kimia | Undergraduate Student | 2 |
| Langlais, Jessica | Undergraduate Student | 2 |
| Malhus, Ben | Undergraduate Student | 2 |
| Mason, Emma | Undergraduate Student | 1 |
| Maurice, Gregory | Undergraduate Student | 0 |
| McCluskey, Bradley | Undergraduate Student | 3 |
| Otterson, Samantha | Undergraduate Student | 2 |
| Reichel, Kent | Undergraduate Student | 1 |
| Reynolds, Christine | Undergraduate Student | 1 |

| | | |
|-------------------|-----------------------|---|
| Roy, Dayna | Undergraduate Student | 1 |
| Servetas, Jeffrey | Undergraduate Student | 3 |
| Smoot, Spencer | Undergraduate Student | 1 |
| Talbot, Matt | Undergraduate Student | 1 |
| Traxler, Spencer | Undergraduate Student | 1 |
| True, Zach | Undergraduate Student | 3 |
| Wessels, Abbie | Undergraduate Student | 1 |
| Woodward, Becca | Undergraduate Student | 2 |

Full details of individuals who have worked on the project:

Rosemary L Smith**Email:** rosemary.smith@maine.edu**Most Senior Project Role:** PD/PI**Nearest Person Month Worked:** 3

Contribution to the Project: Managed project budget, supervised undergraduates in research projects, developed and presented introductory modules, taught an Intro to Nanotechnology course, with hands-on lab, developed and delivered outreach activities at Middle School.

Funding Support: none**International Collaboration:** No**International Travel:** No

Scott D Collins**Email:** scott.collins@maine.edu**Most Senior Project Role:** Co PD/PI**Nearest Person Month Worked:** 3

Contribution to the Project: Developed and taught the upper division course entitled Nanoscience, supervised undergraduate research, led tours of visitors, and assisted in Nanotechnology minor development.

Funding Support: none**International Collaboration:** No**International Travel:** No

Michael D Mason**Email:** mmason@umche.maine.edu**Most Senior Project Role:** Co PD/PI**Nearest Person Month Worked:** 2

Contribution to the Project: Dr. Mason is a co-PI on this project. He supervised undergraduate research

participants, developed and delivered introductory lectures and laboratory exercises for Biological and Chemical Engineering majors. He also led outreach activities, including public tours of his laboratory, and science instruction at Center Drive School in Orrington Maine.

Funding Support: NA

International Collaboration: No

International Travel: No

Justin Millis

Email: justin.millis@maine.edu

Most Senior Project Role: Other Professional

Nearest Person Month Worked: 2

Contribution to the Project: Justin is the staff process engineer for the UMaine cleanroom. He provided training and lab supervision of undergraduate participants in research.

Funding Support: Justin is a full time staff member, supported by the University of Maine, Institute for Molecular Biophysics.

International Collaboration: No

International Travel: No

Aileen L Co

Email: AileenCo@umche.maine.edu

Most Senior Project Role: Graduate Student (research assistant)

Nearest Person Month Worked: 3

Contribution to the Project: Supervision of undergraduate research participants and assisting with teaching of laboratory exercises for first year biological engineering students.

Funding Support: NA

International Collaboration: No

International Travel: No

Christopher Demers

Email: christopher.demers@maine.edu

Most Senior Project Role: Graduate Student (research assistant)

Nearest Person Month Worked: 1

Contribution to the Project: Christopher developed and delivered a hands-on microfluidics laboratory experience for undergraduates in the Introduction to Nanotechnology course.

Funding Support: Umaine Doctoral Dissertation Fellowship

International Collaboration: No

International Travel: No

Jeremy Grant

Email: Jeremy_Grant@umit.maine.edu

Most Senior Project Role: Graduate Student (research assistant)

Nearest Person Month Worked: 3

Contribution to the Project: Jeremy supervised 4 undergraduate research participants in Dr. Mason's lab, and assisted with the development and delivery of outreach activities and laboratory experiences for undergraduates in CHB 112 -Introduction to Chemical & Biological Engineering.

Funding Support: Maine Cancer Foundation

International Collaboration: No

International Travel: No

David Holomakoff

Email: david.holomakoff@maine.edu

Most Senior Project Role: Graduate Student (research assistant)

Nearest Person Month Worked: 3

Contribution to the Project: David participated in nanoscale research under the supervision of co-PI Mike Mason as an undergraduate, then became a graduate research assistant, participating in the training of undergraduates.

Funding Support: NA

International Collaboration: No

International Travel: No

Anna Sitarski

Email: anna.sitarski@maine.edu

Most Senior Project Role: Graduate Student (research assistant)

Nearest Person Month Worked: 2

Contribution to the Project: Anna supervised 3 undergraduate research participants in the laboratory of Dr. Mike Mason, co-PI, who were involved in the synthesis of Gold nanostars for incorporation into biological systems for continuous SERS assessment.

Funding Support: Maine Cancer Foundation

International Collaboration: No

International Travel: No

James Alley

Email: james.alley@maine.edu

Most Senior Project Role: Undergraduate Student

Nearest Person Month Worked: 1

Contribution to the Project: Synthesis and characterization (TEM, DLS , UV-vis, XPS, and XRD) of Iron oxide nanoparticles for incorporation into biomedical implants. Mechanical testing of Nanocellulose –based nanocomposites and CT scanning.

Funding Support: NA

International Collaboration: No

International Travel: No

Keegan Bate**Email:** Keegan_Bate@umit.maine.edu**Most Senior Project Role:** Undergraduate Student**Nearest Person Month Worked:** 2

Contribution to the Project: Iron oxide/gold nanostar composite nanoparticles for use in MRI contrast imaging. Synthesis and char of iron cores, gold coatings, and star surface geometry using DLS, UV-vis, TEM , XRD and XPS.

Funding Support: Maine Cancer Foundation**International Collaboration:** No**International Travel:** No**Michelle Beauchemin****Email:** michelle.beauchemin@maine.edu**Most Senior Project Role:** Undergraduate Student**Nearest Person Month Worked:** 1

Contribution to the Project: Michelle investigated the metal assisted chemical etching of silicon to produce nanowires and assisted with the preparation of suspended TiO₂ nanoparticles in near neutral pH aqueous media.

Funding Support: NA**International Collaboration:** No**International Travel:** No**Andrew Closson****Email:** andrew.b.closson@maine.edu**Most Senior Project Role:** Undergraduate Student**Nearest Person Month Worked:** 1

Contribution to the Project: Andrew participated in the development of a fluid viscometer instrument that uses diffraction limited optical measurement of nanoparticles for standardization of fluid viscosity designed for <20 µL of surgically sampled biofluids.

Funding Support: NA**International Collaboration:** No**International Travel:** No**Aimee Co****Email:** AimeeCo@umche.maine.edu**Most Senior Project Role:** Undergraduate Student**Nearest Person Month Worked:** 2

Contribution to the Project: Aimee participated in the synthesis and characterization of silver nanoparticles for incorporation into composite films.

Funding Support: Maine Cancer Foundation and Paper Surface Science Program of UMaine (Pulp and Paper Industry Consortium)

International Collaboration: No

International Travel: No

Casey Fichter

Email: casey.fichter@maine.edu

Most Senior Project Role: Undergraduate Student

Nearest Person Month Worked: 1

Contribution to the Project: Casey participated in the development of a fluid viscometer instrument that uses diffraction limited optical measurement of nanoparticles for standardization of fluid viscosity designed for <20 µL of surgically sampled biofluids.

Funding Support: NA

International Collaboration: No

International Travel: No

Edward Fratto

Email: Edward_Fratto@student.uml.edu

Most Senior Project Role: Undergraduate Student

Nearest Person Month Worked: 3

Contribution to the Project: Synthesis and characterization (TEM, DLS , UV-vis, XPS, and XRD) of Iron oxide nanoparticles for incorporation into biomedical implants. Mechanical testing of Nanocellulose –based nanocomposites and CT scanning.

Funding Support: UMaine Sustainable Forest Bioproducts REU

International Collaboration: No

International Travel: No

Joshua Fuhrer

Email: Joshua_Fuhrer@umit.maine.edu

Most Senior Project Role: Undergraduate Student

Nearest Person Month Worked: 3

Contribution to the Project: Joshua participated in research project involving the metal assisted etching of silicon to produce nanowires with p/n junction, and making contacts to create solar cells.

Funding Support: Joshua was an NSF REU participant in the separately funded UMaine REU Sensors site during summer 2014.

International Collaboration: No

International Travel: No

Kimia Kashkooli

Email: kimia.kashkooli@gmail.com

Most Senior Project Role: Undergraduate Student

Nearest Person Month Worked: 2

Contribution to the Project: Kimia participated in a research and engineering project surface modification of microcapillaries for use in microviscometry. This was part of her senior capstone project in engineering. She also trained and supervised 3 other undergraduate students in Dr. Mason's laboratory.

Funding Support: NA

International Collaboration: No

International Travel: No

Jessica Langlais

Email: Jessica_Langlais@umit.maine.edu

Most Senior Project Role: Undergraduate Student

Nearest Person Month Worked: 2

Contribution to the Project: Synthesis of Gold nanostars for incorporation into biological systems for continuous SERS assessment. Synthesis and characterization using conventional nanoparticle techniques, as well as optical char in dark field and Raman microscope geometries.

Funding Support: NA

International Collaboration: No

International Travel: No

Ben Malhus

Email: benjamin.melhus@maine.edu

Most Senior Project Role: Undergraduate Student

Nearest Person Month Worked: 2

Contribution to the Project: Ben participated in nanoparticle research as part of his senior capstone project in engineering. He performed synthesis and characterization of gold nanostars using conventional nanoparticle techniques, as well as optical characterization in dark field and Raman microscope geometries.

Funding Support: NA

International Collaboration: No

International Travel: No

Emma Mason

Email: emma.mason@maine.edu

Most Senior Project Role: Undergraduate Student

Nearest Person Month Worked: 1

Contribution to the Project: Emma participated in the formation of CoCrMo alloyed nanoparticles via mechanical degradation of hip implants for use in toxicological studies.

Funding Support: NA

International Collaboration: No

International Travel: No

Gregory Maurice

Email: Gregory_Maurice@umit.maine.edu

Most Senior Project Role: Undergraduate Student

Nearest Person Month Worked: 0

Contribution to the Project: Gregory participated by evaluating the status and applicability of an x-ray CT instrument for a 3D imaging research project.

Funding Support: NA

International Collaboration: No

International Travel: No

Bradley J McCluskey

Email: Bradley_Mccluskey@umit.maine.edu

Most Senior Project Role: Undergraduate Student

Nearest Person Month Worked: 3

Contribution to the Project: Brad participated in the xperimental design, synthesis and characterization of gold and silver nanoparticles for biomedical applications. Brad led laboratory exercises in gold nanoparticle synthesis and DLS size measurement for 1st year students in CHB 112 and 1st and 2nd year engineering students in Intro to Nanotechnology course.

Funding Support: Maine Cancer Foundation

International Collaboration: No

International Travel: No

Samantha L Otterson

Email: samantha_otterson@umit.maine.edu

Most Senior Project Role: Undergraduate Student

Nearest Person Month Worked: 2

Contribution to the Project: Samantha participated in the synthesis and characterization of silver and gold nanoparticle standards for toxicology studies.

Funding Support: NA

International Collaboration: No

International Travel: No

Kent Reichel

Email: kent.reichel@maine.edu

Most Senior Project Role: Undergraduate Student

Nearest Person Month Worked: 1

Contribution to the Project: Synthesis and characterization (TEM, DLS , UV-vis, XPS, and XRD) of Iron oxide nanoparticles for incorporation into biomedical implants. Mechanical testing of Nanocellulose –based nanocomposites and CT scanning.

Funding Support: NA

International Collaboration: No

International Travel: No

Christine Reynolds

Email: christine.reynolds2@maine.edu

Most Senior Project Role: Undergraduate Student

Nearest Person Month Worked: 1

Contribution to the Project: Christine participated in the formation of CoCrMo alloyed nanoparticles via mechanical degradation of hip implants for use in toxicological studies.

Funding Support: NA

International Collaboration: No

International Travel: No

Dayna Roy

Email: dayna.roy@maine.edu

Most Senior Project Role: Undergraduate Student

Nearest Person Month Worked: 1

Contribution to the Project: Iron oxide/gold nanostar composite nanoparticles for use in MRI contrast imaging. Synthesis and char of iron cores, gold coatings, and star surface geometry using DLS, UV-vis, TEM , XRD and XPS.

Funding Support: NA

International Collaboration: No

International Travel: No

Jeffrey Servetas

Email: jeffrey.servetas@maine.edu

Most Senior Project Role: Undergraduate Student

Nearest Person Month Worked: 3

Contribution to the Project: Jeffrey participated in nanoscale research under the supervision of co-PI Mike Mason.

Funding Support: NA

International Collaboration: No

International Travel: No

Spencer Smoot

Email: spencer.smoot@maine.edu

Most Senior Project Role: Undergraduate Student

Nearest Person Month Worked: 1

Contribution to the Project: Spencer assisted Professor Smith in development of a brochure describing the nanofabrication equipment at UMaine, as part of a work-study project to introduce and educate him in the field.

Funding Support: Federal work study.

International Collaboration: No

International Travel: No

Matt Talbot

Email: matthew.w.talbot@maine.edu
Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 1

Contribution to the Project: Matt participated in the synthesis and study of Gold nanostars for incorporation into biological systems for continuous SERS assessment.

Funding Support: NA

International Collaboration: No
International Travel: No

Spencer Traxler
Email: spencer.traxler@maine.edu
Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 1

Contribution to the Project: Spencer participated in the development of a fluid viscometer instrument that uses diffraction limited optical measurement of nanoparticles for standardization of fluid viscosity designed for <20 μ L of surgically sampled biofluids.

Funding Support: NA

International Collaboration: No
International Travel: No

Zach True
Email: zachary.true@maine.edu
Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 3

Contribution to the Project: Zach participated in the formation of coCr Mo alloyed nanoparticles via mechanical degradation of hip implants for use in toxicological studies. He assisted in the construction of mechanical wear device, collection of nanoparticles, size separation, and characterization.

Funding Support: Maine Cancer Foundation

International Collaboration: No
International Travel: No

Abbie Wessels
Email: abbie.wessels@maine.edu
Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 1

Contribution to the Project: Abbie participated in the synthesis and study of Gold nanostars for incorporation into biological systems for continuous SERS assessment. She employed synthesis and characterization using conventional nanoparticle techniques, as well as optical characterization in dark field and Raman microscope geometries.

Funding Support: NA

International Collaboration: No

International Travel: No

Becca Woodward

Email: beccachristinejoy@hotmail.com

Most Senior Project Role: Undergraduate Student

Nearest Person Month Worked: 2

Contribution to the Project: Iron oxide/gold nanostar composite nanoparticles for use in MRI contrast imaging. Synthesis and char of iron cores, gold coatings, and star surface geometry using DLS, UV-vis, TEM , XRD and XPS.

Funding Support: NA

International Collaboration: No

International Travel: No

What other organizations have been involved as partners?

| Name | Type of Partner Organization | Location |
|-----------------------|-------------------------------------|------------------|
| Center Drive School | School or School Systems | Orrington, Maine |
| Doughty Middle School | School or School Systems | Bangor, ME |

Full details of organizations that have been involved as partners:

Center Drive School

Organization Type: School or School Systems

Organization Location: Orrington, Maine

Partner's Contribution to the Project:

Facilities

Personnel Exchanges

More Detail on Partner and Contribution:

Doughty Middle School

Organization Type: School or School Systems

Organization Location: Bangor, ME

Partner's Contribution to the Project:

Facilities

Personnel Exchanges

More Detail on Partner and Contribution:

What other collaborators or contacts have been involved?

NO

Impacts

What is the impact on the development of the principal discipline(s) of the project?

The new Nanoscience course and Nanotechnology Minor developed as a result of this project are likely to impact the education and experiences of undergraduate engineering majors at the University of Maine by providing them with an introduction to nanoscience and engineering that they would not otherwise have. No previously existing coursework covered nanoscience concepts, and no prior nanotechnology curriculum content was available to UMaine students. The impact is already evidenced through student enrollment in the Nanotechnology Minor and the increase in the number of undergraduates participating in nanotechnology research.

What is the impact on other disciplines?

The new course and minor are not restricted to engineering majors. In fact, the Nanoscience course is cross-listed as a Chemistry course and an Electrical & Computer Engineering course. One Chemistry major has enrolled in the Nanotechnology minor, after completing the Nanoscience course.

What is the impact on the development of human resources?

Over 250 first year, undergraduate engineering majors at UMaine were introduced to nanotechnology. Twenty seven undergraduate students participated in experimental research pertaining to nanotechnology, and of these, five have declared a Minor in Nanotechnology. Five engineering graduate students, working on nanotechnology research projects, gained experience in teaching through training and supervision of undergraduates, in course-related lab exercises and in research activities.

What is the impact on physical resources that form infrastructure?

An upgrade to the instructional AFM was made that enables tapping mode operation, for demonstrations of DNA and nanoparticle imaging. These demonstrations are performed during visits to local middle schools, on campus outreach activities and events, and in the classroom. AFM imaging of a DVD was demonstrated and explained in the first year Introduction to Electrical & Computer Engineering course, to 47 first year engineering students. It was also used by 8 students who took the Intro to Nanotechnology course (GEE 298) in Fall 2014, and demonstrated to 12 students enrolled in the Nanoscience course (CHY 477/ECE 457).

What is the impact on institutional resources that form infrastructure?

Nothing to report.

What is the impact on information resources that form infrastructure?

Nothing to report.

What is the impact on technology transfer?

Nothing to report.

What is the impact on society beyond science and technology?

Approximately 70 middle school students at Doughty Middle School participated in an experiment to determine if TiO₂ nanoparticle exposure would affect the heart rate of Daphnia. The students were engaged in a discussion about the environmental impact of new technology, and the importance for scientists and engineers to consider the broader impacts of their research. About 60 first grade students at the rural K-8 Center Drive School in Orrington Maine participated in science education activities at their school with a nanotechnology theme, led by co-PI Mason and his graduate students. Hundreds of K-12 students and their teachers or 4H leaders from Maine participated in tours and hands-on activities at the University of Maine, led by the PI and co-PIs. For most of the students, their visit to UMaine was the first introduction to nanotechnology.

Changes/Problems

Changes in approach and reason for change

Nothing to report.

Actual or Anticipated problems or delays and actions or plans to resolve them

Nothing to report.

Changes that have a significant impact on expenditures

Nothing to report.

Significant changes in use or care of human subjects

Nothing to report.

Significant changes in use or care of vertebrate animals

Nothing to report.

Significant changes in use or care of biohazards

Nothing to report.