

APPENDIX 12: UNIVERSITY OF CALIFORNIA LOS ANGELES/CENTER FOR SCALABLE & INTEGRATED NANOMANUFACTURING PROFILE

I. Description

Institution: University of California, Los Angeles (UCLA)

PI: Xiang Zhang

Co-PIs: Eli Yablonovitch

Title: Center for Scalable & Integrated Nanomanufacturing (SINAM)

Proposal: 0327077

Program Officer: Cheng Sun

Education Outreach Director: Adrienne Lavine, Director, lavine@seas.ucla.edu and David Martinez, martined@seas.ucla.edu

II. Research Agenda

Research Focus:

IRG 1 will focus on top-down nano-lithography, including the Plasmonic Imaging Lithography and Ultramolding Imprint Lithography, aiming toward critical resolution of 1-10nm.

IRG 2 will explore novel hybrid approaches, in combining the top-down and bottom-up technologies to achieve massively parallel integration of heterogeneous nanoscale components into higher-order structures and devices.

IRG 3 will develop system engineering strategies to scale up the technologies developed in IRG 1 and 2, and in product design and development.

NSEC Description: While exciting nano scientific discoveries stream continually from research laboratories, due to the lack of new manufacturing paradigms, scaling to industrial level production still faces critical challenges. We envision two main challenges critical to expedite the nano-technology revolution: (1) the ability to do lithography below 20 nm, and (2) the ability to fabricate 3D complex nanostructures.

III. Education Activities within the University

Description of activities

Nano-Manufacturing Summer Academy (NMSA): The NMSA program is held for an 8-week period in the summer. Participants are college and high school students, who engage in full-time research on a topic related to nano-manufacturing.

New Nano-Courses within UCLA Engineering: Five courses were added or augmented amongst SINAM institutions for 2004. A new undergraduate course, entitled “Bio-NEMS Lab”, was designed and taught by Professors Yong Chen and Jeong-Yeol Yoon of UCLA.

Program staff and expertise

Adrienne Lavine, Ph.D., Mechanical Engineering Professor, third year as Director of Education & Outreach for SINAM. David Martinez, M.S. Operations Research Engineering, first year as Assistant Director of Education & Outreach.

Goals and objectives

- ◆ **Diversity.** Collaboration with programs on our campuses whose objectives are to attract and prepare underrepresented students for the next steps in their education.
- ◆ **Educating SINAM students** at our campuses within a supportive, collaborative environment that fosters their continuing education and research success within the interdisciplinary context of nanomanufacturing.

Target audience (educational levels, number of students at each level, etc.)

High School Level (100), Community College Students(50), Undergraduates(60), Graduate Students(40). All engineering majors.

Current activities

Graduate Young Investigator Award: The GYI is an established program which is successful in supporting student-initiated research. We will monitor how many projects either generate useful results within one year or are incorporated into on-going SINAM research.

Courses: The number of courses is probably sufficient. We need to make courses available between campuses, using either videoconferencing or recorded course lectures.

Nanomanufacturing Summer Academy: The NMSA is an established program which has increased participant diversity in the second year. The desired outcomes are: 1) students express satisfaction with the research project, mentoring, and academic preparation workshops. 2) Undergraduates go to graduate school, high school students go to college in engineering or science.

CEED Engineer-in-Training Workshop (highschool students) and NSF/CEED STEP-UP Convocation (community college and CSU students): These events are coordinated through CEED, the Center for Excellence in Engineering and Diversity, and are based on the MESA model, which has been extensively and positively assessed for its effectiveness in preparing students for four-year institutions.

Nano S&E content focus

Nanomanufacturing, nanolithography, nanoimprinting, nano-Legos, AFM usage, Nanomanipulator

IV. Education Activities Outside the University

Description of activities

Inquiry-Based Module Development & Implementation: Collaborations with faculty from NC State, UNC-Charlotte, the California NanoSystems Institute (CNSI), and the National Center for Learning & Teaching in Nano-scale Science & Engineering (NCLT) have begun in an effort to design inquiry-based learning modules revolving around nano-science principles.

Nano-Manipulator and Haptic Device: SINAM has placed an order for a Nano-Manipulator (nM) and haptic device system to be incorporated into inquiry modules, school science assemblies, 1-2 day classroom workshops, and the LATTC community college nano-technology course. The nM has the capability to take data from an AFM scan of a nano-scale device and create images for students to see. The nM can also be connected to a haptic device that will allow students to virtually “feel” the nano-particle as it is displayed in the nM image.

Joint Collaboration with Los Angeles Trade Technical College: A program is being developed that involves a partnership between Los Angeles Trade Tech community college (LATTC) and UCLA SINAM. The program involves two stages; with the first stage representing a pilot program to serve as the model to expand implementation into the second stage.

New Nano-Courses: A new full-year graduate course series at UCSD incorporates the courses of “Advanced BioPhotonics”, “BioElectronics”, and “BioNanotechnology”. Altogether, the courses had an enrollment of sixty students for the entire year. The series, taught by Professor Mike Heller of UCSD, represents an interdisciplinary approach where the convergence of science and technology spurs the creation of new nanotechnology.

Graduate Young Investigator (GYI) Program:

This is a proposal competition amongst graduate students within SINAM. Three proposals were awarded \$30,000 each for a one-year period starting July 1, 2004 and ending June 30, 2005.

Program staff and expertise

Adrienne Lavine, Ph.D., Mechanical Engineering Professor, third year as Director of Education & Outreach for SINAM. David Martinez, M.S. Operations Research Engineering, first year as Assistant Director of Education & Outreach.

Goals and objectives

- ◆ **CC Outreach.** Reaching out to the community college district and the Los Angeles Unified School District, which serve diverse populations. These are opportunities to expose under-served populations to nanotechnology concepts and the innovative SINAM research.
- ◆ **Outreach to grades 7-12.** Our goals here are to: 1) Raise awareness of and enthusiasm for nanoscale concepts among grade school children. 2) Effectively engage students in nanoscience and nanotechnology modules that awaken an interest and encourage persistence in science or engineering.

Target audience (educational levels, number of students at each level, etc.)

High School Level (300), Community College Students(100)

Current activities

LATTC Phase I: Phase I is the offering of a Nanotechnology course at LA TradeTech College in the Fall. The course will be taught by Dr. Miguel Moreno with two kinds of input from UCLA faculty – advisory input on the curriculum and bringing students into our faculty labs for approximately two lectures.

Nanomanipulator and Haptic Device/Module Development: We will use the Nanomanipulator in three ways. It will be incorporated into the Los Angeles Trade Technical College Nano-technology course (on-deck for Fall). It will be used in grades 7-12 classroom visits in “basic” modules; these are modules that address basic concepts of nanometer scale, nanoscale science concepts, geometry, and trigonometry. These can be developed quickly (for Fall).

Nano S&E content focus

Nanomanufacturing, nanolithography, nanoimprinting, nano-Legos, AFM usage, Nanomanipulator.

Nano S & E content consultants

UCLA Graduate School of Education, UCLA MESA, USC MESA, high school teachers, Lawrence Hall of Science.

V. Education Outreach Materials

Describe and provide examples of materials, outlines, demonstrations, etc. developed for outreach activities for the K-12 and/or informal audiences

MESA Engineers-in-Training Workshops: Mathematics, Engineering, Science Achievement (MESA) operates out of the CEED office at UCLA. The program focuses its efforts on organizing pre-college programs to garner interest for engineering and science amongst K-12 students. This particular event was broken up into three hour-long repeat workshops with students from local high schools (Dorsey, Hamilton, and Morningside) in attendance.

CEED Step-Up Convocation: UCLA SINAM volunteered to attend this event to discuss current nano-manufacturing research and nano-technology principles with students from Cal State Los Angeles and various California community colleges. The event targeted minority serving institutions to promote successful transfer to UCLA and stimulate research interest at UCLA in technical disciplines.

VI. Education Outreach Evaluation

Summarize outreach evaluation plan

Graduate Young Investigator Award: The GYI is an established program which is successful in supporting student-initiated research. We will monitor how many projects either generate useful results within one year or are incorporated into on-going SINAM research.

Nanomanufacturing Summer Academy: The desired outcomes are: 1) students express satisfaction with the research project, mentoring, and academic preparation workshops. 2) Undergraduates go to graduate school, high school students go to college in engineering or science. For #1, we will give a survey. For #2, we will track student progress annually.

LATTC Phase I: An evaluation is written into the project proposal to be done collaboratively by SINAM and LATTC. This will address the number and diversity of students taking the course, the competence of the students in the course material, and their expressed future interest in nanotechnology.

Summarize outreach evaluation results

In Progress

VII. Lessons Learned

List 2-3 lessons learned to share with others embarking on a nano education outreach effort:

- ◆ Collaboration is key, especially with limited staff. Hosting joint events or attending outreach events that other programs (especially diversity programs) host goes far to promote education and diversity agendas.
- ◆ There exists an unlimited amount of programs, centers, and offices that have connections to your target students...all one needs to do is to find them.
- ◆ Have a plan, module, or outline before collaboration is sought. This helps to minimize wasted time and promotes further collaboration and funding

Describe what you might do differently in the future

- ◆ Maximize the assistance of graduate students as they can relay their research to students in imaginative and interesting ways.