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CONNECTICUT STATE UNIVERSITY SYSTEM

INITIATIVE FOR NANOTECHNOLOGY-RELATED EQUIPMENT, FACULTY DEVELOPMENT AND CURRICULUM DEVELOPMENT

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ABSTRACT

The Department of Energy funding of $649,000 provided under this grant was to be used for partial fulfillment of necessary laboratory equipment for course enrichment and new graduate programs in nanotechnology at the four institutions of the Connecticut State University System [CSUS]. Equipment in this initial phase included a variable pressure scanning electron microscope [VP-SEM] with energy dispersive x-ray spectroscopy [EDXS] elemental analysis capability [at Southern Connecticut State University]; power x-ray diffractometer [XRD] [at Central Connecticut State University]; a UV-VIS-NIR spectrophotometer and spectrofluorimeter [at Eastern Connecticut State University]; and a Raman Spectrometer [at Western Connecticut State University]. DOE's funding was allocated for purchase and installation of this scientific equipment and instrumentation. Additional DOE funding was subsequently allocated [$80,000; 3/10/2011- 02/28/2013] to fund the curriculum, faculty development and travel necessary to continue development and implementation of the CSUS Graduate Certificate in Nanotechnology (GCNT) program and the ConnSCU Nanotechnology Center [ConnSCU-NC] at SCSU*. All of the established outcomes have been successfully achieved. The courses and structure of the GCNT program have been determined and the program will be completely implemented in the fall of 2013. The instrumentation has been purchased, installed and have been utilized at each campus for the implementation of the nanotechnology courses, CSUS GCNT and the ConnSCU-NC. Additional outcomes for this grant include curriculum development for non-majors as well as faculty and student research.

*In September of 2011, the Connecticut State Colleges & Universities (ConnSCU) was established as the new administrative structure to govern the four Connecticut State Universities (CSU) and the twelve Connecticut Community Colleges. In the initial grant proposal to the DOE, funding for equipment and curriculum/faculty development was requested to establish a Connecticut State University System Graduate Certificate in Nanotechnology [CSUS GCNT] and a CSUS Nanotechnology Center [CSUS-NC]. With the new change in university administration, these programs will be known to the State of Connecticut as the ConnSCU GCNT and the ConnSCU Center for Nanotechnology [ConnSCU-CN]. However, throughout this report we will use the original language of the grant proposal when referring to the certificate program and the nanotechnology center.

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EXECUTIVE SUMMARY

CONNECTICUT STATE UNIVERSITY SYSTEM INITIATIVE FOR NANOTECHNOLOGY-RELATED EQUIPMENT, FACULTY DEVELOPMENT AND CURRICULUM DEVELOPMENT

In 2010, the Connecticut State University System (CSUS) identified the establishment of nanotechnology programs and infrastructure as a priority. At that time, the system set the goal of establishing an academic initiative in nanotechnology for the CSUS, beginning with the development of a series of courses at the graduate level. Implementation was planned via a collaborative effort including faculty from all four of the CSUS campuses. The CSUS Nanotechnology Working Group [CSUS NWG] was established to accomplish this goal. A faculty member from the Physics Department at Southern Connecticut State University [SCSU] was assigned the task of organizing and coordinating the work of the CSUS NWG. Representatives from each of the four CSUS campuses were appointed to join the CSUS NWG with the following initial representation: SCSU [Physics and Biology], Western Connecticut State University (WCSU) [Chemistry], Eastern Connecticut State University (ECSU) [Chemistry] and Central Connecticut State University (CCSU) [Chemistry]. *Based on the recommendations of the CSUS NWG, this grant was submitted to fund the equipment necessary to initiate the development of a CSUS Graduate Certificate in Nanotechnology* (CSUS-GCNT). As a further outcome it was determined that this collaborative effort would lead to the establishment of a formal nanotechnology center, serving as the nucleus of CSUS student and faculty learning and research. This CSUS Nanotechnology Center [CSUS-NC] was to be located at Southern Connecticut State University (SCSU).

Specifically, the DOE funding of $649,000 provided under this grant was to be used for partial fulfillment of necessary laboratory equipment for course enrichment and new graduate programs in nanotechnology at the institutions in the CSUS. Equipment in this initial phase was to include a variable pressure scanning electron microscope [VP-SEM] with energy dispersive x-ray spectroscopy [EDXS] elemental analysis capability [at SCSU]; power x-ray diffractometer [XRD] [at CCSU]; a UV-VIS-NIR spectrophotometer and spectrofluorimeter [at ECSU]; and a Raman Spectrometer [at WCSU]. DOE's funding was allocated for purchase and installation of this scientific equipment and instrumentation. Additional DOE funding was subsequently allocated [$80,000; 3/10/2011- 02/28/2013] to fund the curriculum, faculty development and travel necessary to continue development and implementation of the CSUS-GCNT program and the CSUS-NC at SCSU.

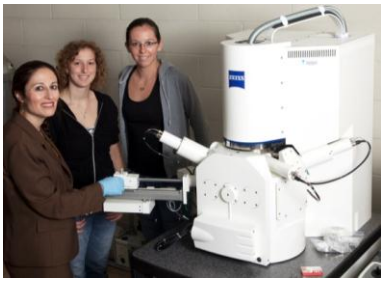
Final vendor selection and purchasing were completed as scheduled for all four campuses with installation and utilization protocols successfully implemented. In all cases, plans were put in place for instrument utilization and associated curriculum and faculty development. Curriculum development and implementation for the proposed CSUS-GCNT program were also completed on schedule with details provided below.

Three of the four proposed graduate level courses have been offered at SCSU. The remaining graduate course has been formally approved and is scheduled to be offered in the summer of 2013 [at SCSU]. Undergraduate nanotechnology themed courses have been developed at each of the other CSU campuses. SCSU has completed the curriculum development necessary to formally establish the CSUS Graduate Certificate in Nanotechnology. Specifically, the GCNT proposal was submitted and approved by the SCSU Graduate Council in

February of 2013 and was formally approved by the SCSU administration in March of 2013. The first class of GCNT holders are scheduled for graduation in the winter of 2013.

For implementation of the current grant, the faculty representatives at each of the four CSUS locations were provided funds directly for the purchase of the instrumentation to be located at that campus. The equipment was identified based on the nanotechnology curriculum development planned at each CSUS campus. These curriculum and programming efforts were expedited by an additional DOE programming grant awarded in March 2011. In parallel with these efforts, the CSUS Nanotechnology Center at SCSU was planned, and with immediate support from the SCSU administration, was implemented. Specifically, SCSU provided the space [additional ~2,000 sq. ft. in Jennings Hall] and the additional resources necessary to initiate all functions of the Center. The proposal for formal establishment of the CSUS-NC was completed and submitted to the CSUS Academic Vice Presidents [CO-AVPs] in January 2012.

The Co-AVPs reviewed the CSUS-NC proposal and recommended that it be submitted to the administrative Board of the CSUS [now the Connecticut Colleges and Universities (ConnSCU)] once the GCNT was officially approved by the SCSU administration. Now that the GCNT has been formally approved, it is expected that the Nanotechnology Center proposal will be submitted to the ConnSCU Board of Regents by the end of the spring 2013 semester. It is planned that the Nanotechnology Center will begin formal operations in summer 2013.




Variable Pressure [VP] Scanning Electron Microscope [SEM] at SCSU

SUMMARY OF OUTCOMES

A. CSUS Graduate Certificate in Nanotechnology

Based on initial discussions, the CSUS-NWG developed a basic framework for the Certificate program that included four required courses [three core courses (offered at SCSU) and one prerequisite course (offered at each of the four CSUS campuses)] designed to meet the following general goals:

1) provide an introduction to nanoscale science and technology;
2) encourage students to pursue related interdisciplinary coursework outside their major;
3) enhance student ability to read and understand published scientific literature;
4) enhance students ability to formulate a research question and to conduct independent research;
5) enhance students business, marketing and communication skills;
6) familiarize students with the real and perceived societal implications of nanotechnology and other emerging technologies, which span from economics to ethics to politics; and
7) provide flexibility in programming allowing for participation by students with diverse backgrounds.

To facilitate implementation and maximize the collective impact of the CSUS-NC and the CSUS-GCNT, the current research and academic interests of the individual campuses were considered. The result was the establishment of a research/academic focus (referred to as a NC-HUB) for each CSUS campus. The primary goal of the NC-HUB structure was enhanced collaboration among the CSU campuses via the development of courses and research thrusts that would potentially utilize the CSUS-NC. With this framework in mind, the CSUS-NWG concluded that a four course program consisting of three CSUS-NC core courses offered at SCSU and one NC-HUB motivated pre-requisite course would best meet these established goals. Specifically, the four courses are:

Nanotech I: *Fundamentals of Nanoscience*[1] (3 credits):

i. serve as a core course offered by SCSU within the CSUS-NC
ii. include lecture and demonstrations
iii. offer the possibility of distance learning for the lecture component (facilitating faculty and student participation from all CSUS campuses).
iv. would make use of the VP SEM purchased via the DOE grant primarily for demonstrations

Nanotech II: *Characterization of Nanomaterials*[1] (3 credits):

i. serve as a core course offered by SCSU within the CSUS-NC
ii. include lecture and demo/laboratory format
iii. offer the possibility of distance learning for lecture component (facilitating faculty and student participation from all CSUS campuses).

[1] Nanotech I and Nanotech II are also core courses in the SCSU Professional M.S. in Applied Physics.

iv. would make primary use of the VP SEM purchased via the DOE grant

Nanotech III: ***Nanotechnology NC-HUB Elective*** **(3 credits):**

i. serve as a required pre-requisite course offered by a NC-HUB at one of the four CSU campuses [students are required to select one Nanotech III course based on individual interest and/or campus location]
ii. offered at the undergraduate or graduate level
iii. lecture and demo/laboratory format
iv. possibility of distance learning for lecture component
v. would make primary use of the DOE funded instrumentation at each NC-HUB

Nanotech IV: ***Nanosystems Laboratory*** **(3 credits):**

i. serve as a capstone research experience for the Graduate Certificate
ii. serve as a core course offered within the CSUS-NC
iii. laboratory format
iv. will be team-taught with faculty bringing projects for students to work on at the CSUS-NC (using Center resources including electron and atomic force microcopy)
v. include common interdisciplinary research theme, i.e. high resolution imaging and nano-characterization
vi. would make primary use of the VP SEM purchased via the DOE grant as well as DOE funded instrumentation at each NC-HUB

All four of the courses described above have been completely developed and have been approved by the SCSU Graduate Council. Nanotech I, II and III have also been offered at SCSU with over 25 students to date impacted. Nanotech IV was recently approved by the SCSU Graduate Council and will be offered in the summer of 2013.

Undergraduate Nanotech III courses have been developed at each of the other CSUS campuses. These courses have been approved by the appropriate faculty and administrative entities for each campus. All of the finalized course descriptions are included below. Given the course offerings and the approval of the Graduate Certificate in Nanotechnology program, the major outcomes of the DOE grant have been achieved.

B. Instrument installation, approved courses and additional outcomes

Instrument selection was undertaken with the primary goal of obtaining instrumentation that would be used to implement the proposed CSUS-GCNT. Specifically, at SCSU, a Variable Pressure [VP] Scanning Electron Microscope [SEM] was identified as the highest impact instrument for the courses to be developed. This instrument ideally complemented SCSU's existing nanotechnology and materials science facilities that include transmission electron and scanning probe microscopes [TEM, SPM] as well as complementary synthesis and nanofabrication capabilities. The VP SEM is a highly versatile instrument with applicability in both the life and physical sciences. It is ideally suited for lecture demonstrations, laboratory components as well as student research. It was further determined that SCSU could leverage existing equipment and additional bond funding to add complementary analytical capabilities to the instrument.

After a rigorous evaluation of several different instrument manufacturers, the ZEISS SIGMA VP SEM was identified as the optimal instrument. In addition to the variable pressure capability, the instrument selected included scanning transmission electron microscopy [STEM], cathodoluminescence [CL] and a field emission [FE] source. As a further advantage, the SIGMA VP SEM was ideally suited for an upgrade that included energy dispersive X-ray spectroscopy [EDXS] for elemental analysis. The instrument chosen additionally has the capability of remote access providing the opportunity for classes at other campuses to view data collection in real time. The instrument was installed in August of 2011 [commission date November 2011] and implementation of the curriculum development component was immediately initiated. This instrumentation has been used in the following approved and implemented courses:

PHY 519 - Nanotech I: Fundamentals of Nanoscience
Course credits: 3
Pre-requisites: Modern Physics, General Chemistry II or equivalent or department permission
Course description: This course provides a broad and highly interdisciplinary introduction to the science of nanoscale materials (nanoscience). Topics include fundamental definitions, historical background, synthesis and characterization techniques, physics and chemistry of nanoscale materials, nanoscale applications, and ethical/societal/business considerations. The VP SEM is used for lecture demonstrations for this course.

PHY 521 - Nanotech II: Characterization of Nanomaterials
Course credits: 3
Pre-requisites: PHY 519 or department permission
Course description: The principles of ray and wave optics are applied to imaging systems and electron microscopy with applications including reflecting and refracting surfaces, image formation, polarization, diffraction and interference. Particular emphasis is placed on the fundamental limitations of the system and the resulting image. The theoretical and practical concepts of transmission electron microscopy (TEM) and scanning electron microscopy (SEM), including hands-on opportunities for students to learn how to operate the state of the art SEM and its attached analytical accessories. The VP SEM is used extensively for this course.

PHY 522 - Nanotech III: Nanoscale Fabrication and Synthesis
Course credits: 3
Pre-requisites: PHY 519 or department permission
Course description: Fundamentals of condensed phase nucleation and growth are applied to the synthesis of nanoscale structures. Properties of condensed matter at the small scale, including the effects of the increasing surface to volume ratio are considered. The course includes an overview of the synthesis and fabrication techniques employed to produce nanostructures, and an introduction to the methods of nanostructure characterization including SEM and TEM. Laboratory visits and hands-on experience with state-of-the-art synthesis and characterization techniques include extensive use of the VP SEM.

PHY 523 - Nanotech IV: Nanosystems and Laboratory
Course credits: 3
Pre-requisites: Nine credits in nanotech/nanoscience courework or department permission
Course description: This course serves as a hands-on capstone experience for the CSUS Graduate Certificate in Nanotechnology program and provides opportunities for experimentation using advanced methods specific to synthesis and characterization of nanoscale materials. The emphasis is on materials characterization techniques suitable to studying materials on the nanoscale including atomic force microscopy [AFM] and electron microscopy [SEM, TEM]. The VP SEM will be used extensively for this course. Students will submit a formal written report and oral presentation of their experimental work.

At SCSU the instrumentation and curriculum development efforts supported by the grant have additionally impacted the development and implementation of nanotechnology and materials science infused courses at the undergraduate [majors and non-science majors] and graduate level. For undergraduate non-science majors, SCSU has recently engaged in a major reform of its General Education [All University Requirements] Program resulting in the establishment of the Liberal Education Program [LEP]. The LEP is designed to prepare students for the 21st Century. This program includes a Technological Fluency requirement for all students. Technological fluency is defined as the knowledge and/or use of electronic tools and software and requires students to engage in electronic collaboration, create documents and presentations, and use graphical and multimedia technology. Currently, these skills are highly demanded in fields which develop advanced materials and are the backbone of the National Academies developed Frameworks for K-12 Science Education[2]. SCSU has created a course that uses Nanotechnology as a context for teaching technological fluency. This course is called "PHY 120: Physics for Tomorrow, Nanotechnology". This course has been offered during the last four semesters and has, to date, impacted over 200 students.

SCSU also recently established an engineering concentration for its BS in Physics Degree. Students in this degree program earn a BS in Physics while also taking coursework in engineering, computer science and chemistry. Once again, with the benefit of the current grant, SCSU developed several new courses including, for example, PHY 398 "The Science of Nanostructures". This course has been offered several times and has impacted over 20 students. Subsequent to the development of PHY 398, the Department approved the addition of a new course EGR 232 "Materials Science and Engineering", which also includes a substantial component of nanotechnology. This course is being offered during the current semester.

The DOE funded instrumentation has also been utilized for undergraduate research, both formally via capstone research courses [PHY 471 and PHY 499], and via research internships. Several of the students participating in this research have presented their work at regional as well as international meetings and, in both cases, research publications are in progress. These students were further inspired to establish an undergraduate chapter of the Materials Research Society

[2] *A Framework for K-12 Science Education: Practices, Crosscutting Concepts, and Core Ideas*, National Academies Press (2012)

[MRS]. The MRS is the international professional organization for materials research and has a substantial nanotechnology component. The SCSU MRS Chapter is one of only a few undergraduate chapters at a primarily undergraduate institution.

SCSU offers a variety of graduate level courses for practicing teachers via its Masters in Science Education Program. Several nanotechnology themed courses were developed and offered over the last two years. In both cases the DOE funded instrumentation at SCSU played a prominent role. The courses include SCE 575 "Integrated Science Experience: Interdisciplinary Research in Materials Science, Microscopy and Nanotechnology" and IDS 571 "Science Laboratory Practice: Microscopy and Nanotechnology". To date over 20 middle and high school teachers have taken these courses and have been impacted by the instrumentation. Evaluation results from the students in these classes consistently indicate that hands-on access to cutting-edge research tools is a highly effective approach for teaching science content as well as the scientific method. The teachers taking these classes have also developed curricular modules based on their experiences. Follow-up evaluations indicate that teachers have used these materials and several teachers have also scheduled follow-up tours and workshops with their students.

At CCSU a power X-ray Diffractometer was determined to be the optimal instrument for purchase. Specifically the MiniFlex II is a desktop and portable powder x-ray diffraction system that can be used both in the laboratory and out in the field. Its compact size and excellent price-to-performance ratio enable MiniFlex II users to incorporate XRD analysis into scientific programs where it had previously been considered infeasible due to budgetary or physical location constraints. Industrial users have discovered the MiniFlex II as a great tool for Quality Control. With its minimal power requirements and no need for cooling water, the MiniFlex II can be installed practically anywhere. This instrumentation has been used in the following approved and implemented courses:

CHEM 100 *Search in Chemistry: Nanochemistry [Spring 2011]*
Course credits: 3
Prerequisites: none
Course description: This general chemistry introductory course was taught to 38 students with topics focusing on nanotechnology, nanochemistry, and nanomedicine. At the start of the course, the topics covered were the basics of chemistry: structure of the atom, bonding, stoichiometric relationships, measurements, and the scientific method. This introduction was followed by an overview of the instrumentation that allowed for measurements and observations at the atomic level. The instructor then branched into nano topics such as nanomaterials, nanomedicine, and molecular machines. Students loved the class; but unfortunately, due to load restraints in the semesters that followed, the course has yet to be offered a second time.

Also at CCSU the instrumentation has been used in the development of a one credit Upper-Level undergraduate Nanomaterial based Separations Lab [CHEM 462 *Advanced Inorganic Lab]*.
Over the time period of the grant, the faculty purchased some materials (column chromotgraphy columns, solvents, and chemicals) and developed a separations lab. The purpose of the lab was to do a series of extractions to remove abundant fullerenes (C_{60} and C_{70}) from fullerene soot.

Students could run column chromatography in order to visibly separate the two fullerenes. Students then could calculate percent yield (or recovery) as well as determine purity via ^{13}C NMR studies.

As an additional outcome at CCSU, the power diffractometer has supported research publications for Molecular Network Research at CCSU [1,2,3]. Three publications resulted from the research funded. All three papers were published in the international crystallography journal *Acta Crystallographica*. All three papers were related to the silver-quinoxaline molecular network project. Whereas one paper focused on a silver(I) complex with a ligand of interest, the other two dealt with intermediates that were made during the multi-step synthesis of the silver-quinoxaline salts. All synthesis, purification, characterization, and single crystal X-ray diffraction studies were performed in house with undergraduate researchers.

At WCSU a Raman Spectrometer was chosen for purchase. The Raman spectroscopy plays a major role in the discovery of the electronic and phonon properties of advanced nanomaterials. The unique Raman spectrum was observed in single-wall nanotubes due to the one-dimensional confinement of electronic and phonon states. Nanotubes are an essential element to next-generation solar cells and solar to fuel conversion. In order to show and further study these nanotubes and their properties to students, Raman spectroscopy was needed, which was not available in any of the CSUS universities.

WCSU decided on a Raman Station 4000 from Perkin Elmer to meet their specified needs, including a specific spectrum range and resolution. Within the target price range, it was the best choice. In addition, this model allows for a future upgrade to a tip-enhanced model if needed, which can be obtained through future research proposals. The instrument was installed in December of 2011 and implementation of the curriculum development component was immediately initiated. This instrumentation has been used in the following approved Nanotech III course:

CHE 398 - Nanotech III: Properties and Applications of Nanomaterials
Course credits: 3
Pre-requisites: Analytical Chemistry Lecture and Lab. Organic Chemistry I.
Co-requisites: Physical Chemistry I or permission by instructor
Course description: The course starts with an introduction to the properties of nanoscale materials such as nanomechanics, nanoscale heat transfer, electrical and optical properties intrinsically associated with their low dimensionality, and the quantum confinement effect. Critical components in potential nanoscale device applications such as liquid crystals, light emitters, photoconductors, photoresists for nano- and microelectronics, nano-based solar cells and solar to fuel conversion, and optical information storage, are also covered. The class meets for lecture three hours per week.

During implementation of the new nanotechnology class "Properties and Applications of Nanomaterials", WCSU faculty and students traveled to and utilized the facilities at the CSUS Nanotechnology Center at SCSU. Specifically faculty and students traveled to SCSU to visit the Nanotechnology Center, where students were able to see first-hand the practicality of various nano-instruments such as SEM, TEM and AFM. The VP SEM was the primary instrument for this visit due to its ease of use yet research grade capabilities.

As additional outcomes, before the award of this grant, WCSU included no official course or curriculum in nanotechnology. Because of this funding, WCSU faculty were not only able to offer a course in the field, but were also able to reach out to other schools outside the system with an established nanotechnology program such as Worcester Polytechnic Institute (WPI). Specifically WCSU has joined the NanoWorcester Conference and, as a result, is beginning to have a stronger nanotechnology presence. In addition, WCSU has initiated the use of the Raman Spectrometer for research in studying the vibrational properties of metal organic framework (MOF) compounds, which are developed for nonlinear optical materials.

At ECSU several different instruments were purchased. The Horiba Jobin Yvon Fluorolog 3-11 Research Spectrofluorometer was chosen for the emission wavelength range that extends to 1550 nm. The Hitachi U4100 UV-Visible Near-Infrared spectrophotometer was selected for the sample compartment dimensions and for its ability to measure the electronic spectrum of solid thin film samples. The WaveNow potentiostat was preferred for its portability, current sensing range in the nanoamps, and USB interface for control and data acquisition. Bucky paper made of carbon nanotubes in thin films is used as electrodes for electrochemical measurements. During the preparation of electrodes, the fluorescence signal and electronic absorption spectrum of the raw carbon nanotubes are monitored.

The fluorescence measurements were made using the Horiba Jobin Yvon Fluorolog 3-11. This photon counting research grade spectrofluorometer covers the carbon nanotube fluorescence emission range up to 1550 nm. It also comes with Nanosizer, - a software package that characterizes the diameter and chirality of single walled carbon nanotubes. The electronic absorption spectrum up to 2600 nm is acquired with the use of Hitachi U4100 UV-Visible Near-Infrared spectrophotometer. This instrument has a 200 x 200 mm sample compartment that accommodates electrochemical cells for spectroelectrochemical measurements. A Pine Instruments WaveNow portable potentiostat that measures current in the nanoamp range was used to control the potential of the carbon nanotube electrodes. These instruments are used in the following approved course:

CHE 430 - Nanotech III: Nanosystems Laboratory: Applications of Basic Spectroscopy, Separations, and Electrochemistry to Nanomaterials
Course credits: 3
Pre-requisites: Organic Chemistry II, Physics with Calculus II
Course description: This course applies the theory and practice of basic chemical instrumentation to nanomaterials. The scope is limited to the analysis of metal, metal oxide, and semiconductor nanoparticle samples using electronic and fluorescence spectroscopy, chromatography and centrifugation separations, and electrochemical methods of analysis.

Additional outcomes for ECSU include the approval of CHE430 by the Eastern Connecticut State Univerisity Liberal Arts Work (LAW) Committee as satisfying the LAW course requirement for graduating students. Also, the DOE funded instruments were used by Biochemistry students in Chemical Instrumentation, Directed Research, and Independent Study courses.

CONCLUSIONS

The primary goal of this grant was the purchase of the equipment necessary to facilitate the development and implementation of a collaborative Graduate Certificate in Nanotechnology for the Connecticut State University System. This outcome has been successfully achieved. The courses and structure of the Graduate Certificate program have been developed and approved and the program will be completely implemented in the fall of 2013. The instrumentation has been purchased, installed and have been utilized at each campus for the implementation of nanotechnology courses as well as the Graduate Certificate. Additional outcomes for this grant include curriculum development for non-majors as well as faculty and student research. As a further outcome that was initiated by this grant (and was further supported by a follow-up programming grant), a CSUS wide Nanotechnology Center has been implemented and will be formally established at SCSU in the summer of 2013. Also during the award period, the Connecticut State University Universities and Colleges [ConnSCU] system was established. This system includes the CSUS as well as the CT Community Colleges. The Nanotechnology Center will be recognized as the ConnSCU Center for Nanotechnology and will thus impact both the CSUS and Connecticut Community College Systems.

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