May 6, 2010

David W. Pershing  
Senior Vice President for Academic Affairs  
205 Park  
Campus

Dear Vice President Pershing,

Enclosed is the proposal for the University of Utah Graduate Training Program in Nanotechnology which was approved with formatting changes by the Graduate Council on February 22, 2010. Included in this packet are the proposal, the executive summary and the signature page.

Please forward this proposal to the Academic Senate to be placed on the calendar for the next meeting of the Senate.

Sincerely,

Charles A. Wight  
Dean, The Graduate School
Nanotechnology Training Program

Application to Graduate Council for
approval to establish an interdepartmental Graduate Training
Program in Nanotechnology
Approved February 22, 2010 pending formatting revisions

Submitted by

Hamid Ghandehari, PhD,
Co-Director, Nano Institute of Utah;
USTAR Professor, Departments of Pharmaceutics & Pharmaceutical Chemistry;
and Bioengineering

Patrick Tresco, PhD,
Associate Dean for Research, College of Engineering
Section I: Request

The Nano Institute of Utah (NIU) requests approval to establish an interdepartmental Graduate Training Program in Nanotechnology at the University of Utah effective Fall 2010. The revised program was reviewed and approved by the Graduate Council on February 22, 2010, pending revisions to the format.

Section II: Program Description

Complete Program Description

The new interdepartmental Graduate Training Program in Nanotechnology will provide breadth and depth in the emerging field of nanoscience and nanotechnology and will include graduate students from across the University including departments in the Colleges of Science, Engineering, Pharmacy, and the School of Medicine, where they will get their respective PhD degrees. Program focus will be on training entering students in areas of University of Utah strengths in nanotechnology research, including, but not limited to, nanomaterials, interfacial nanosciences, nanobiosensors, nanomedicine, and systems integration.

Purpose of Degree

The proposed training program in nanotechnology will provide cohesive training for students from several departments of the Colleges of Science, Engineering, Medicine and Pharmacy, at the University of Utah. Successful training in this area will require dedicated interactions between a multitude of disciplines including chemistry, physics, materials science and engineering, cellular biology, and pharmaceutical sciences. The proposed graduate program is non-degree granting, and is analogous in structure to the Molecular Biology (MB) Program and the Biological Chemistry (BC) Program on campus. The recruitment process from among participating department graduate program applicants will start during Spring 2010 for Fall 2010 admission.

This program will initially support first year funding for five (5) entering PhD (or MD/PhD, PharmD/PhD) students per year from a cross-section of departments on campus, a graduate program coordinator, and funds for student recruitment. The students will rotate through two to three different labs during their first year funded by this program and in subsequent years will join a lab of participating program faculty that can provide a graduate research assistantship in research topics in nanotechnology.

Institutional Readiness

While an independent degree for this training program is not being requested, there is a need to formally establish, strengthen and seek support internally for first year training that will be leveraged by applications for formal training grants to the NSF or NIH. Universities across the country (e.g., U Washington, Cornell, Maryland, Johns Hopkins, among others) have established similar programs. In 1987 a grass-roots effort of faculty from the UofU Department of Biology and several medical school departments led to development of the current graduate MB Program, which now coordinates graduate student recruiting and training in molecular biology. The teaching and administrative activities of this program are organized by interdepartmental committees of cooperating faculty members. The interdepartmental nature of the MB Program meshes well with the interdepartmental traditions of the other graduate programs on campus including Bioengineering and Pharmaceutics. Subsequently a campus-wide UofU BC Program was established for Biology/Chemistry, designed along the lines of the MB Program, and works closely with that program. A campus-wide UofU Neurosciences Program has been started recently which is also structured like the MB program. It recruits and trains students in neurobiology, biophysics, and behavioral science.
Other active interdepartmental training programs on campus include Multidisciplinary Cancer Research and Chemistry-Biology Interface Training Programs. The UofU program will build on the history of excellence in interdepartmental training programs as well as on the well-recognized accomplishments in the areas such as nanobiosensors, nanobiomaterials and nanomedicine on campus. Over 50 faculty at the University are currently members of the NIU and membership is growing. The proposed program integrates well with the focus of USTAR clusters in nanotechnology, biomedical device innovation, personalized medicine, and other emerging clusters. A similar organization for this new interdisciplinary will ensure open faculty participation and governance.

Already several courses in nanoscience and nanotechnology exist on campus; "Nanoscience: Where Biology, Chemistry and Physics Intersect (5810/6810)" is taught every Spring Semester and is an introduction to the emerging fields of nanoscience and nanotechnology. The course is cross-listed among various departments and is taught by Shumaker-Parry (Chemistry), Gerton (Physics) and Porter (Chemistry, Chemical Engineering, Bioengineering and Pathology). The course "Introduction to Nanobiotechnology and Nanomaterials (MSE 5071/6071)" is taught by Ostafin (Materials Science and Engineering) and focuses on nanomaterials with particular relevance to life science applications.

"Nanoscale Imaging and Probing (MSE6050)" is a recent course introduced by Zang (Materials Science and Engineering) covering the basic principles of electronic microscopy and scanning probe microscopy and spectroscopy, and the broad applications in nanoscale probing and imaging. In addition, Ghandehari (Pharmaceuticals and Bioengineering) is planning to introduce a new course in Nanomedicine beginning Fall 2010 which will be cross-listed between Bioengineering and Pharmaceuticals departments. This course will cover the continuum of fundamentals of nanomedicine, nanomaterials used for therapeutic and diagnostic purposes, methods for their characterization, biological evaluation, imaging, and preclinical and clinical translation. Clearly the didactic course infrastructure is in place for the training program. Students enrolling in the Graduate Training Program in Nanotechnology at the UofU will be required to take at least two of these courses as electives toward the completion of their home department degree. The new program will have a curriculum committee consisting of a faculty representative from each department to continue to improve program curricula.

Excerpts from the Molecular Biology and the Biological Chemistry programs have been used as guidelines for the curriculum of the Nanotechnology Training Program described below:

The UofU operates on the semester system. First-year graduate students begin their studies in August, although they may elect to arrive earlier in the summer to accommodate an additional lab rotation. Prior to their arrival, each student is assigned a faculty advisor, who will provide guidance on first-year curriculum and laboratory rotation choices.

All Ph.D. students admitted to the Nanotechnology Training Program receive financial support (fellowship - $25,000 for the 2010-2011 academic year, tuition waiver, and health and dental insurance) throughout the entirety of their graduate student tenure. First year financial support of the admitted students will come from the program while they complete their rotations. Beginning the second year financial support will be picked up by primary advisor.

Required Courses: Nanotechnology Training Program students take two full-semester length core courses that have been designed to provide students with a solid background in fundamentals of basic and applied nanotechnology. By the end of the first year of study, all students are expected to have fulfilled the
program's core requirements (grades of B- or better). The program's required core courses are listed below:

1. Nanoscience: where Biology, Chemistry and Physics Intersect (5810/6810) (full Semester, Spring) [Provides fundamentals of nanotechnology in the basic sciences]
2. Introduction to Nanobiotechnology and Nanobiomaterials (MSE 5071/6071) [Covers applications of nanotechnology in biology and medicine]

Currently these courses are both offered every Spring Semester. They can be rearranged with the consensus of faculty involved to be offered in Fall and Spring respectively.

**Electives.** Nanotechnology Training Program students, will need to take an additional full semester of elective course. These are didactic courses designed to help students gain proficiency in specialized areas of interest. Listed below are examples of nanotechnology elective courses. However it must be noted that the students need not limit themselves to take any of these courses and can take an array of electives offered by individual departments/programs from which they will obtain their degree from (e.g., bioengineering, chemistry, etc.).

1. Nanoscale Imaging and Probing (MSE 6050) (full Semester, Spring)
2. Nanomedicine (Special Topics, BIOE/PHCEU) (full Semester, Fall even years)

The two required courses along with one elective will complement the core courses required by the degree program in which after completion of first year the students will enroll in. (For example if a student enrolls in the chemistry graduate program, she/he will need to complete the requirements of chemistry graduate program and can use the three nanotechnology related courses towards electives.)

**Ethics.** Case Studies in Research Ethics, will be taken in the fall semester of the first year of graduate study. In this class, students discuss ethical issues of scientific research and integrity. Specific topics include scientific fraud, conflicts of interest, plagiarism, authorship designation, and the role of science in formulating social policy.

**Journal Club/Grant Writing.** Nanotechnology Training Program students take a journal club/grant writing course in the Spring semester of the first year of their studies. This journal club/grant writing course is designed to give students practice in: (1) reading and analyzing the scientific literature; (2) presenting formal seminars on selected topics, and (3) writing and critiquing grants. Each journal club is supervised by one or two faculty members, who assist students in selecting articles and in organizing presentations and grants. Student grants are critiqued in mock study sections.

**Seminars.** The Nano institute has ongoing seminars in collaboration with member departments on campus. Students in the first year of the Nanotechnology Training Program are required to attend these seminars and in subsequent years are encouraged to do so.

**Laboratory Rotations.** Nanotechnology Training Program students complete a minimum of two (required) to three (optional) laboratory rotations in their first year of graduate study. Laboratory rotations are essential to identifying the appropriate thesis mentor and lab. In addition laboratory rotations expose students to a wide variety of research areas and contacts. To assists students in identifying productive and exciting laboratory rotation experiences, Program faculty present short talks about their research programs during the fall semester. Program faculty talks inform students about the diversity of possible thesis topics and the variety
of experimental approaches employed in the different Program laboratories. Participating faculty's research interests will also be published online to assist students in identifying the mentor and research areas.

**Choosing a Mentor.** Students choose thesis advisors at the end of Spring semester of first year. Since nanotechnology research is interdisciplinary, students are encouraged, but not required, to choose a co-mentor as well. The primary mentor (student advisor) is responsible to supervise the students. The secondary mentor if chosen will assist the students in complementary subject areas (e.g., primary materials science, secondary radiology for development of novel diagnostics). Arrangements are made by mutual agreement between mentors and students, and automatically admit the student to the degree program of the advisor's department within the colleges of Science, Engineering, Pharmacy, and the School of Medicine where they will get their respective PhD degrees. These can potentially span to other colleges (e.g., Humanities) to cover ethical, legal and social aspects of nanotechnology. All Program faculty members strive to arrange space in their labs so that they can accommodate at least one thesis student from each Nanotechnology Training Program class. The low student/faculty ratio in the Nanotechnology Training Program contributes to a high level of student choice and to an outstanding training environment.

**Certificate.** At the completion of their degree students will receive their PhD (or MD/PhD, PharmD/PhD, etc.) in their respective department or College with a certificate in nanotechnology.

**Faculty**

Faculty who are members of the NIU are involved in nanotechnology research and education and will comprise the backbone of the Nanotechnology Training Program. The NIU membership currently consists of over fifty (50) tenured or tenure-track faculty and seven (7) nontenure-track researchers, all having Ph.D.'s or M.D.'s. The membership of the institute is growing and the NIU anticipates that it will reach 70-80 within the next year. They come from many academic departments across our campus including:

- Anesthesiology
- Biochemistry
- Bioengineering
- Chemical Engineering
- Chemistry
- Electrical and Computer Engineering
- Geology & Geophysics
- Materials Science & Engineering
- Mechanical Engineering
- Medicinal Chemistry
- Metallurgical Engineering
- Obstetrics & Gynecology
- Pathology
- Pediatrics
- Pharmaceutics & Pharmaceutical Chemistry
- Pharmacology
- Toxicology
- Physics & Astronomy
- Radiology

Together they form the pool of researchers, educators and practitioners committed to solving interdisciplinary challenges in nanoscience and nanotechnology. This faculty pool in an integrated fashion is involved in teaching the nanotechnology courses and dedicated to providing the training for the graduate students. The proposed inter-departmental training program will be open to participation of any faculty member across the University campus and involved with nanotechnology research through a simple application process.

**Faculty Research Areas.** Existing research among University faculty and their collaborators covers a broad range of nanoscience and nanotechnology research themes that can be divided into five major areas including: Nanomaterials, Interfacial Sciences, Nanomedicine, Nanobiosensors, and System Integration and Reliability representing faculty from the Colleges of Engineering, Pharmacy, and Science; the Health Sciences campus including the School of Medicine and Huntsman Cancer Institute. The following is an abbreviated selection of such faculty:

**Nanomaterials,** Amy Barlos & Glenn Prestwich – attaching gold compounds to hyaluronic acid polymers as potential therapies for chronic inflammation; Michael Bartl – control and manipulation of photons in optical integrated circuits and photonic chips; Feng Liu – structural and mechanical properties of strained bi-layer nanoscale thin films; Mark Miller – solid-state devices and materials engineered at the molecular scale; Agnes Ostafin – functional nanoreactors that can be used for long-term tracking of biochemical markers of disease; Ashutosh Tiwari – characterization of spin polarized light emitting diodes, and development of a
laser-assisted plasma-based processing technique for creating super hard and tough nanocomposite coatings for harsh-environment applications; Gerald B. Stringfellow and Michael Scarpulla – nano and quantum dot based optoelectronic materials and devices; Anil Virkar and Florian Solzbacher – defect chemistry based electroceramic and metal oxide materials for gas and humidity sensing in harsh environments.

Interfacial Sciences. John Conboy – protein adsorption, phase segregation in lipid membranes, and ion transport between immiscible liquids; Joel Harris – spectroscopic methods for molecular structure and dynamics at interfaces; Jennifer Shumaker-Parry – high-throughput sensing methods for molecular recognition between biomolecules; Loren Rieth and Florian Solzbacher – (i) thin film high temperature compatible metal semiconductor interfaces, reliability and failure modes; (ii) thin film biocompatible encapsulation for physiological and wet environments, reliability and interface based failure modes; Marc Porter – interfacial characterization (infrared and Raman spectroscopy, optical ellipsometry, scanning tunneling and atomic force microscopy), reactivity at liquid-solid interfaces (acid-base chemistry, surface modification, protein-protein, protein-DNA interactions).

Nanomedicine. You Han Bae – application of intelligent polymeric micelle systems in the 50 nm range to target cancer cells; David Bull & Sun Wan Kim – polymer/DNA complexes for delivery of endothelial growth factor for neo-vascular formation and improvement of tissue function in ischemic myocardium; Jindrich Kopecak – Design and development of polymer-drug conjugates for targeted treatment of cancer; David Grainger, Agnes Ostafin, John Veranth & Garold Yost – the effect of nanoparticle size and shape on cellular production of reactive oxygen species; and delivery of endogenous substances on nanoparticle surfaces and toxicity signals in cells; Hamid Ghandehari – the influence of size, geometry, porosity and surface functionality of silica nanotubes, silica nanoparticles and dendrimers on toxicity, cellular uptake, biodistribution and pharmacokinetics, developing polymeric constructs that target sites of tumor angiogenesis, maximizing localization of radionuclides in the tumor and minimizing nonspecific uptake by other organs; Vladimir Hlady & Patrick Tresco – generating novel surfaces that resemble the native surface of nervous system cells to improve implant performance; JoAnn Lighty – soot growth and oxidation; William Johnson – biological effects of nanomaterials for ecological monitoring studies under field conditions. Marc Porter - influence of size, geometry, surface functionality of gold and silver nanoparticles on cellular uptake and enzymatic release of nanoshell durg content.

Nanobiosensors. Steve Blair – nucleic acid, protein, and cell-based microarrays for medical discovery and diagnostics; Rich Brown – microolithography techniques to produce an array of microelectrodes allowing chemical detection on a scale near that of a single neuron; Bruce Gale – nanoparticle analysis and separation using field flow fractionation; Marc Porter – nanometrically engineered, biologically active surfaces for ultralow detection of biomarkers and pathogen and combination of real world testing, reagent design, and development capabilities with innovations in ultrasensitive detection, high speed sample manipulation, and advances in nanometric materials; Mikhail Skliar – fringe-effect sensors for noninvasive measurements for the thickness of dielectric films; Henry White – applications in biosensing, DNA sequencing and electrophysiology using a single conical-shaped nanopore embedded in a 50 mm glass membrane; Florian Solzbacher, Richard A. Normann, Reid R. Harrison, Greg C. Clark, Bradley Greger, Paul House – neural interfaces for multi channel single neuron recording and stimulation in neuroprosthetic applications and neurological disorders (epilepsy, etc.); Florian Solzbacher, Jules Magda: hydrogel based implantable sensors and systems for metabolic monitoring, diabetes, obesity, chronic infections, etc.; Ling Zang – detection of environmentally relevant hazardous metals via single-molecule imaging and molecular
probing; Jennifer Shumaker-Parry – surface plasmon resonance-based sensing and spectroscopy platforms for biomolecule analysis.

System Integration and Reliability. Florian Solzbacher – (i) chronically implantable, integrated wireless neural interfaces; (ii) integrated hydrogel based metabolic sensors, (iii) implantable pressure sensors; Erik Jung (Fraunhofer IZM, Utah) – EGrains, flip chip micro and nano hybrid system integration; Prashant Tathireddy (Fraunhofer IZM Utah, U of U) – commercial projects, ultra small scale flip chip micro and nano hybrid system integration.

Staff
The proposed organizational structure of the Nanotechnology Training Program will comprise a Director and Co-Director reporting to the U Senior Administration and working with a Steering Committee.

Proposed Training Program Organizational Chart

U of U Senior Administration

Program Director
Co-Director

Program Coordinator

Steering Committee

Curriculum Committee

Recruiting & Admission Committee

Student Advisor

U Senior Administration: Senior Vice President for Academic Affairs, Senior Vice President for Health Sciences, Vice President of Research, Deans of the Colleges of Engineering, Pharmacy and Science.

Program Director and Co-Director: The Program Director with the support of the Co-Director will ensure that all aspects of the Nanotechnology Training Program function as proposed. They need to formally establish, strengthen and obtain support during the first year training experience. Initially Hamid Ghandehari and Patrick Tesco will serve as Director and Co-Director of the Program for the first three years, respectively. Every three years new Director and Co-Director will be elected by the participating faculty.

- Establish, strengthen and obtain internal institutional support
Nano Institute of Utah

- Set policies and long-term goals for the program
- Ensure shared governance and broad applicability of the program.
- Direct the work of the Program Coordinator
- Initiate and supervise elections of participating faculty
- Elected by participating faculty to a 3 year term after initial 3 year term

Steering Committee: Senior investigators from the Colleges of Sciences, Engineering, Pharmacy, and the School of Medicine
- Meets monthly
- Guides strategic functions
- Selects trainees,
- Monitors trainee performance
- Ensures that there will be representation from multiple departments and colleges in the various committees
- Elected by participating faculty to a 3 year term

Program Coordinator: Full-time staff member reporting to the Program Directors
- Provides staff support for the activities of the Nanotechnology Training Program as defined by the Director and Co-Directors
- Prepares and sends out printed recruiting information
- Arranges interview visits
- Determines student selection for program admission
- Maintains contact with and encourages students until final decisions are made

Recruiting & Admissions Committee (See Admission requirements below)

Curriculum Committee
- Formulates curriculum policy
- Organizes the courses required by the Program
- Evaluates the quality of the courses each year with the Utah Center for Teaching and Learning using:
  - Anonymous written student surveys
  - Mid-term reviews
  - Exit interviews with students
- Recommends changes to improve course quality
- Representatives from each college and if possible each participating department when multiple faculty are participating

Student Advisor
- Meets quarterly with first-year students
- Monitors students progress in coursework
- Monitors students progress in lab rotations
- Hired by program director
- Reports to program directors

Membership on each of the committees will be reassigned by the Steering Committee every three years with feedback from faculty and students. Students will elect each year a representative to work with the program administrators on students' needs and issues.

Library and Informational Resources
Library and informational resources are available in each trainee's department.

Admission Requirements
The Recruiting & Admissions Committee will outline the admission requirements, and in addition will:
- Ensure that highest quality students are supported by the training grant
- Ensure that the students' course work is chosen appropriately
- Ensure that the students' academic progress is monitored closely
- Resolve academic problems for the students' ultimate benefit
- Ensure that students are placed in the labs most likely to give the highest quality research training
- Recruit representatives from each college and, if possible, from each participating department when multiple faculty are participating

Student Advisement
Students will have ample access to counsel and advice from faculty and student advisors. Prior to their arrival, each student is assigned a faculty advisor, who will provide guidance on first-year curriculum and laboratory rotation choices. The Student Advisor will meet quarterly with first-year students, monitors their progress in coursework and monitors their progress in lab rotations. Students will choose their thesis advisors at the end of Spring semester of first year and will begin working closely with that advisor in laboratory and course work. Since nanotechnology research is interdisciplinary, students are encouraged, but not required, to choose a co-mentor as well who will also provide guidance.

Justification for Graduation Standards and Number of Credits
At the completion of their degree students will receive their PhD (or MD/PhD, PharmD/PhD, etc.) in their respective department or College with a certificate in nanotechnology. To be eligible for the certificate in nanotechnology students will be required to take at least two nanotechnology courses as electives toward the completion of their home department degree.

External Review and Accreditation
No external consultants, either in- or out-of-state, were involved in the development of the proposed program. Both the UoFU MB and the BC programs have been used as guidelines for the curriculum of the Nanotechnology Training Program. There is no special professional accreditation available for a certificate in nanotechnology.

Projected Enrollment
The program will initially support first year funding for five (5) entering PhD (or MD/PhD, PharmD/PhD) students per year from a cross-section of departments on campus.

Section III: Need

Program Need
Like the MB and BC programs, the new interdepartmental training program in nanotechnology will provide strong and cohesive training for graduate students entering several departments in the Colleges of Science, Engineering, Pharmacy, and the School of Medicine, where they will get their respective PhD degrees. Program focus will be on training students in areas of our strengths in nanotechnology research, including, but not limited to, nanomaterials, interfacial nanosciences, nanobiosensors, nanomedicine, systems integration and others.
Labor Market Demand

Training students with interdisciplinary capabilities will provide a workforce for the growing nanotechnology industries. For example, the demand for nanotechnology medical products is projected to grow by more than 17% annually to reach $53 billion in 2011. Other areas of nanoscience and nanotechnology are growing by similar rates. Given these trends and technology directions, there is a need for training interdisciplinary scientists in nanotechnology to address this demand in research and the development of new products.

Innovations in the highly interdisciplinary field of nanotechnology are blurring the boundaries of the traditionally structured fields of medicine, information technology, energy, biotechnology, electronics, sensing and control, and many more. Our country is committed to taking the lead in the emerging fields of nanoscale science, engineering and technology, as evidenced by the formation of the National Nanotechnology Initiative (NNI) in 2001 to support long-term, fundamental research in nanoscience. NNI funds are distributed among 25 U.S. federal departments and agencies, including NSF, NIH, NASA, EPA, and the Departments of Defense, Energy, and Homeland Security. Growth in NNI funding for nanotechnology research has exploded in recent years as the identification of new potential applications has grown exponentially. In fiscal year 2010, the NNI budget is $1.6 billion, more than triple the budget of its first year. The new training program will be developed to meet this need and positioned to allow University researchers and faculty to take advantage of these new opportunities.

Student Demand

Students trained in traditional graduate programs of each of the classic disciplines lack the skills necessary to tackle the interdisciplinary challenges required to successfully integrate nanotechnology. Successful development of sophisticated constructs for the 21st century requires the training of a new generation of scientists that are able to work across a multitude of disciplines including chemistry, materials science, engineering, and pharmaceutical sciences. Training students with interdisciplinary capabilities will also provide a workforce for the growing nanotechnology industries.

Similar Programs

The proposed graduate program is non-degree granting, and is analogous in structure to the Molecular Biology (MB) Program and the Biological Chemistry (BC) Program on campus but is not in competition with either of these other successful biology programs.

Collaboration with and Impact on Other Utah System of Higher Education (USHE) Institutions

Many universities across the country (e.g., U Washington, Cornell, Maryland, Johns Hopkins, among others) have already established similar programs on their respective campuses. The Utah program will build on the history of excellence in interdepartmental training programs as well as on the well-recognized accomplishments in the areas such as nanobiosensors, nanobiomaterials, and nanomedicine on campus. Approximately 50 faculty at the university are currently members of the NIU and membership is growing. The proposed program integrates well with the foci of USTAR clusters in nanotechnology, biomedical device innovation, personalized medicine, and other emerging cluster. The program is open to applications from students finalizing their bachelor degrees in other state institutions.

Benefits
Major recent advances in nanotechnology require training of a new generation of scientists who are able to work across a multitude of disciplines including chemistry, materials science, engineering, and pharmaceutical sciences. Training students with interdisciplinary capabilities will provide a workforce for the growing nanotechnology industries.

Consistency with institutional Mission
The new interdepartmental training program in nanotechnology will provide breadth and depth in the emerging fields of nanoscience and nanotechnology and will include graduate students from across the University including departments in the Colleges of Science, Engineering, Pharmacy, and the School of Medicine, where they will get their respective PhD degrees. This is consistent with the mission of the NIU as the program focuses on training entering students in areas of NIU strengths in nanotechnology research, including, but not limited to, nanomaterials, interfacial nanosciences, nanobiosensors, nanomedicine, systems integration and others.

Section IV: Program and Student Assessment

Program Assessment
The program will be monitored closely by the senior investigators from the Colleges of Sciences, Engineering, Pharmacy, and the School of Medicine who make up the Steering Committee. They will meet monthly to provide guidance for the program, monitor trainee performance and ensure representation from multiple departments and colleges in the various committees.

Expected Standards of Performance
Students enrolling in the Graduate Training Program in Nanotechnology at the University of Utah will be required to take at least two elective courses in nanotechnology as part of their requirements for completion of their home department degree.

Section V: Finances

Budget

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\textsuperscript{1}Budget expected to increase by 4% per year

Funding Sources
Funding for Year 1 of the program has been provided by the office of the Senior Vice President of Research. Subsequent years funding will be allocated pending considerations for long-term support for new interdepartmental graduate programs.
Nano Institute of Utah

04/26/2010

2. Annual Salary-$40,000 & Benefits-$14,400
3. Tuition Differential at $1,000 per student for some departments
4. Student Recruitment: Website Information; Brochure, Student visits (travel, etc.), Manning
   recruitment weekends

I. Attached Letters of Support

David W. Grainger, Chair, Department of Pharmaceutics & Pharmaceutical Chemistry; Thomas N. Parks,
Vice President for Research; Richard D. Rabbit, Chair, Department of Bioengineering; Henry S. White,
Chair, Department of Chemistry

Institutional Signatures

________________________
Chief Academic Officer

________________________
Graduate School Dean

________________________
President
Graduate Council
University of Utah

Re: Proposed Nanotechnology Graduate Training Program (Prof. Ghandehari)

To the Graduate Council:

I write to endorse the Graduate Council’s serious consideration and approval of the proposal from Prof. Hamid Ghandehari to establish an interdepartmental Graduate Training Program in Nanotechnology at the University of Utah. This program, one of several like it emerging now nationally, will serve the internationally increasing need to train advanced students in aspects of nanotechnology and applications of nanoscience to diverse fields, including medicine, engineering, chemistry, biology and physics. The need is acute: nanotechnology markets are growing at double-digit growth rates, with several sectors valued at billions of dollars already, and the National Nanotechnology Initiative (NNI) has broad interagency agreements to fund nanotechnology-related research in many fields. Prof. Ghandehari’s program seeks to appropriately tap the many opportunities in both academic programming and preparing a new work force of capably trained students. His proposal attempts to address this growing, popular need by building a bridging training program, analogous to the Utah Molecular Biology and Biological Chemistry non-degree granting training programs, across many departments on campus conducting research in this area.

This building effort for this new training program is bold and ambitious but it cannot simply emerge spontaneously on this campus without encouragement and support. Ghandehari’s proposal requests support to fund 10 entering PhD (or MD/PhD) students annually from a cross-section of departments on campus, a graduate program coordinator, and funds for student recruitment and curriculum development. Newly recruited students will rotate in multiple labs during their first year, supported by this program and, in subsequent years, will join labs that provide continuing funding in this broad area. To his credit, Prof. Ghandehari has sincerely tried to ‘rally the troops’ on this campus to nucelate this effort. He is recognized as a national thought-leader in the nanotechnology field. He has submitted over $10 million dollars in new multiple-PI nanotechnology proposals in the past 2 years, including mega-proposals to the NIH for nanotechnology graduate training. He has produced the new Utah Nano Institute with colleague Marc Porter. He has organized and run two successful “NanoUtah” scientific symposia featuring national speakers in a local forum.

In summary, we have a recognized leader on our campus with the desire and credentials to run a program on the fore-front of an emerging field. He has successfully located and rallied most if not all campus faculty who work and contribute in this field into an orchestrated group for proposals, education and joint work. He has proposed a very nice initiation phase and method for his training concept, and exploits the capabilities on our campus to host and promote this new effort.

I look forward to seeing this new training program grow on our campus and urge you to support it.

Sincerely,

David W. Grainger, Ph.D.
Professor and Chair
January 14, 2010

Graduate Council
University of Utah

Dear Colleagues:

I write in strong support of the proposal by Profs. Hamid Ghandehari and Patrick Tresco to create an interdepartmental graduate program in nanotechnology. Students in this program would generally receive their degrees from the department in which their thesis advisor has a primary faculty appointment and be supported by the program for the first year and by faculty research funds in subsequent years. The proposal outlines a curriculum that would include specialized courses in nanomaterials, interfacial nanosciences, nanobiosensors, nanomedicine, and systems integration (among others), integrating current courses with new ones developed for the Nanotechnology Program. In my opinion, nanoscience as a field of research has a broad enough reach and a sufficient number of practitioners on our campus that it is timely to establish a separate interdepartmental training program in this field here.

The program has requested central support at a level per student similar to that received by the interdepartmental programs in Biological Chemistry, Molecular Biology and Neuroscience. Senior Vice Presidents Pershing and Betz and I are considering this request.

Sincerely,

[Signature]

Thomas N. Parks, Ph.D.
Vice President for Research
January 14, 2010

Dr. Chuck Wight  
Dean, Graduate School  
University of Utah  
Salt Lake City, UT 84113

Re: Graduate Training Program in Nanotechnology

Dear Dr. Wight,

As Chair of the Department of Bioengineering, I am delighted to support the proposal led by Dr. Hamid Ghandehari to establish a Ph.D. graduate training program in nanotechnology at the University of Utah. The proposed program dovetails with the requirements of our Ph.D. program and will: 1) synergize efforts in multiple units to offer training in this important area, 2) improve the graduate experience at the University of Utah, 3) enhance interactions between faculty and students across departments, 4) enhance the quality and quantity of didactic graduate courses, 5) accelerate the pace of scientific discovery and progress, 6) increase the visibility of the University of Utah, and 7) serve as a platform to recruit the best and brightest Ph.D. students to Utah. As you know, the University of Utah was recently awarded an NSF IGERT training grant led by Dr. Marc Porter – a grant that will help launch the proposed program. These extramural funds provide an immediate match for the University investment. In addition, Dr. Ghandehari has submitted a training grant proposal in the nanomedicine area that I am confident will ultimately lead to additional funding to support incoming students. Nanotechnology is a growing and well funded area at the University of Utah. All graduate students recruited into the program will be matched with, and placed into, funded laboratories to support timely completion of their Ph.D. research. The proposed training program is structured similar to the Combined Program in Molecular Biology and will make an excellent addition to the high quality graduate programs already in place at the University. I am truly looking forward to working with the training program leadership team to establish Utah as world-class leader for graduate education in this rapidly growing nascent area.

Sincerely,

[Signature]

Richard D. Rabbitt, Ph.D.  
Prof. and Chair, Bioengineering
Executive Summary
University of Utah
Nanotechnology Training Program
26 April 2010

Program Description

The proposed Nanotechnology Training Program is non-degree granting, and is analogous in structure to the Molecular Biology (MB) Program and the Biological Chemistry (BC) Program on campus. This program will support funding of five (5) entering PhD (or MD/PhD) students per year from a cross-section of departments on campus, a graduate program coordinator, and funds for student recruitment and curriculum development. The students will rotate in multiple labs during their first year funded by this program, and subsequent years will join labs that can provide funding in nanotechnology. The proposed training program in nanotechnology provides cohesive training for students from several departments of the Colleges of Science, Engineering, and Pharmacy, at the University of Utah. Successful training in this area requires dedicated interactions between a multitude of disciplines including chemistry, physics, materials science and engineering, cellular biology, and pharmaceutical sciences.

Upon approval we intend to start the recruitment process from among participating departmental graduate program applicants during Spring 2010 for Fall 2010 admission.

Role and Mission Fit

Like the MB and BC programs, the new interdepartmental training program in nanotechnology will provide strong and cohesive training for graduate students entering several departments in the Colleges of Science, Engineering, Pharmacy, and the School of Medicine, where they will get their respective PhD degrees. Program focus will be on training students in areas of our strengths in nanotechnology research, including, but not limited to, nanomaterials, interfacial nanosciences, nanobiosensors, nanomedicine, systems integration and others.

Faculty involved in nanotechnology research and education will comprise the backbone of the program. Successful training in nanotechnology requires dedicated interactions between a multitude of disciplines and departments including chemistry, physics, materials science and engineering, biology, bioengineering, electrical engineering, pharmaceutics, and internal medicine, to name a few. The proposed interdepartmental training program incorporates faculty members across the University campus and will be open to additional interested faculty via formal application.

Faculty will come from numerous academic departments across our campus and the Nanotechnology Training Program will not serve as a tenured home for these faculty. Consequently, the participating faculty do not fit appropriately in the categories listed in the next section labeled "Faculty".

Faculty

Please indicate the number of discipline specific faculty and level of preparation of the faculty who will support the program. Tenure includes already tenured and tenure-track.

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Number of faculty with Master's degrees 
Number of faculty with Bachelor's degrees 
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**Market Demand**

The demand for nanotechnology medical products, for example, will grow by more than 17% annually to reach $53 billion in 2011. Other areas of nanoscience and nanotechnology are growing by similar rates. Given these trends and technology directions, there is a clear need for training the next generation of interdisciplinary scientists in nanotechnology to address this demand in research and translational new products. Our country is committed to taking the world lead in research in the emerging fields of nanoscale science, engineering and technology, as evidenced by the formation of the National Nanotechnology Initiative (NNI) in 2001 to support long-term, fundamental research in nanoscience. NNI funds are distributed among 25 U.S. federal departments and agencies, including NSF, NIH, NASA, EPA, and the Departments of Defense, Energy, and Homeland Security. Growth in NNI funding for nanotechnology research has exploded in recent years as the identification of new potential applications has grown exponentially. In fiscal year 2010, the NNI budget is $1.6 billion, more than triple the budget of its first year.

**Student Demand**

Students trained in traditional graduate programs of each of the classic disciplines lack the skills necessary to tackle the interdisciplinary challenges required to successfully integrate nanotechnology. Successful development of sophisticated constructs for the 21st century requires the training of a new generation of scientists that are able to work across a multitude of disciplines including chemistry, materials science, engineering, and pharmaceutical sciences. Training students with interdisciplinary capabilities will also provide a workforce for the growing nanotechnology industries.

**Statement of Financial Support.**

Indicate from which of the following the funding will be generated: (Provide the detail for funding as part of the “Financial Analysis” section included in the full proposal.)

- Legislative Appropriation □
- Grants □
- Reallocated Funds ×
- Tuition dedicated to the program □
- Other □

**Similar Programs Already Offered in the USHE**

Many universities across the country (e.g., U Washington, Cornell, Maryland, Johns Hopkins, among others) have already established similar programs on their respective campuses. The Utah program will build on the history of excellence in interdepartmental training programs as well as on the well-recognized accomplishments in the areas such as nanobiosensors, nanobiomaterials and nanomedicine on campus. More than 50 faculty at the University are currently members of the Nano Institute of Utah and membership is growing. The proposed program integrates well with the foci of USTAR clusters in nanotechnology, biomedical device innovation, personalized medicine, and other emerging clusters.
MEMORANDUM

To: Graduate Council, University of Utah

From: Henry S. White, Chair

Date: January 14, 2010

Subject: Nanotechnology Training Program

I support the establishment of an interdepartmental Graduate Training Program in Nanotechnology.

Our faculty in chemistry have worked over the years on the design of various constructs for interfacial sciences, biosensors, advanced diagnostics as well as other areas of nanotechnology. In addition, chemistry faculty have developed courses in nanoscience to provide interdisciplinary training for students in traditional graduate programs. Chemistry faculty are actively engaged in integrating and advancing nanoscience and nanotechnology via interdisciplinary activities including, but not limited to, the Nano Institute of Utah and the IGERT Program focused on nanobiosensors, nanomaterials and microfluidics.

The proposed program provides additional opportunities for our faculty to furnish students at the undergraduate, graduate and professional levels with the skills to establish interdisciplinary collaborations that will be necessary for them to capitalize on new and emergent nanotechnology research applications.