

NANOTECHNOLOGY SAFETY EDUCATION THE BEGINNINGS

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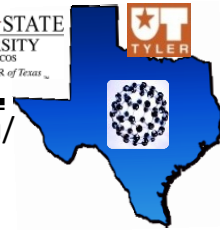
MNT 2013 Conference
May 21st, 2013



OUTLINE

- Nanomaterials Application Center [NAC]
 - Dissemination of information
- Texas State System Nano-Safety
- Dr. Tate's Nanomaterials Lab
- Susan Harwood Grant from OSHA
- Texas State & UT Tyler Collaboration
- NSF Award for Nanotechnology Safety
- 1st Course Offerings





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IEEE FELLOW & SPIE FELLOW

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Texas State University-San Marcos

Past Director

- Center for Emerging Technology Commercialization, The University of Texas at Austin
- Nanomaterials Application Center, Texas State University-San Marcos

13 years at SEMATECH, Senior Fellow of the Technical Staff

12 years at GE, nine on Corporate Staff (manufacturing/technology)

Founded two companies, Director at a third start-up

Technology Futurist:

- Nanotechnology: single digit nanometer materials, nanotechnology safety, education
- Energy: nanoelectronics, nanosensors, nanosystems, picoWatt systems
- Semiconductors: advanced lithography, med-bio

Business: emerging technologies, commercialization, mentoring

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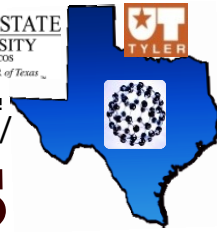


NSF-NUE

NANOMATERIALS APPLICATION CENTER

- Created as a joint effort between Texas State and Applied Nanotech, Inc.
- Officially launched in early 2003 and was transitioned to industry in 2011.
- Focus was to promote dissemination of information on nanotechnology and assist startup ventures.
- Advisory Board of academia and industry.
- Board meeting held monthly.
- Director was Texas State faculty.





NANOTECHNOLOGY IN TEXAS

2003 to 2005

- Creation of the Texas Emerging Technology Fund (startup and early stage focused).
- Strong nanotube based companies operating.
- Texas Nanotech Initiative (private).
- Rice University is a major presence.
- Numerous universities developing capabilities.
- Attempts at creating a Texas focused international conference.
- Semiconductor industry moving into nanotechnology.
- NAC launches a Nanotechnology Colloquium.



NAC EVOLVES

2006 - 2010

- NAC was located within Texas State University.
- Support was by member funding.
- Dissemination was by the Colloquium and presentations at various shows.
- Colloquia were held every two weeks and sponsored by the law firm of Winstead.
- Colloquia were broadcast to major Texas cities, Austin, Dallas, Houston, San Antonio via the local offices of Winstead.
- Speakers were primarily local, but remote broadcasting was done from major US and European cities.
- Industry expert brought in as Director of NAC.



NAC EXPANDS

2006/7

- Additional members join.
- Interactions with Rice University and Rice Alliance established.
- Number of nanotech companies in Texas exceeds 250.
- nanoTox, Inc. (nano toxicity startup) actively works with NAC.
- Other companies across Texas actively interact with NAC and Texas State.
- White paper on Nano-Safety issued by NAC encompassing 4 stages of safety evaluation.



NANO-SAFETY

There are four pillars to Nano-Safety

1. Material Properties
 2. Impact on People and the Environment
 3. Handling of Nanomaterials
 4. Business Focus
- The Educational efforts focus on items 3 & 4.
 - The proper means of handling, controlling, applying nanomaterials is not necessarily obvious but techniques can be taught.
 - The business focus is an educational process that involves the understanding of the proper handling, etc., and also the record keeping and control of product, which builds from #3.



TEXAS STATE UNIVERSITY SYSTEM

2008

- A meeting of representatives of Lamar University, Sam Houston State, University, Sol Ross University, and Texas State was held to evaluate the means of coordinating nanotechnology applications across the system.
- The result was an agreement to coordinate efforts among the various locations.
- Professor Dominick Fazarro of Sam Houston was a driving force in focusing follow up efforts.
- His involvement was both through collaboration with Texas State personnel and through focusing national organizations, like ATMAE, on the special requirements of nanotechnology and the need for sections within organizations focused on nano.

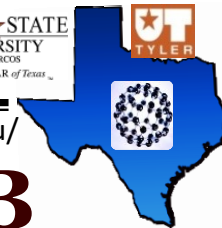


NANOMATERIALS LAB

2009

- Based on ongoing efforts in nanotechnology safety, Professor Jitendra Tate needed to develop a nanomaterials lab.
- He called all the safety officers and experts at Texas State into a conceptual design meeting.
- Result was a design that would both protect students and train them in the proper handling of nanomaterials.
- With the lab operational, he submitted the first of many NSF proposals on nano-safety education.
- A number of these were rejected for a number of reasons including “for being needed but ahead of its time.”





<http://nsf-nue-nanotra.engineering.txstate.edu/>

NANOMATERIALS SAFETY LAB



NANOPARTICLE CONTAINMENT ROOM

- This is 8 ft. x 10 ft. hard-wall ready-made clean room
- This room maintains negative pressure and there is dedicated exhaust to this room (with blower on the roof).
- The filters used are ULPA (Ultra-Low Penetration Air) Filters rated 99.999% efficient with particles 0.12 microns (120 nm) in diameter. Traditional HEPA filters are good up to 0.3 microns (300 nm) with rated efficiency of 99.98%.
- Researchers who would like to use this room have to wear half-mask respirator, lab suit, and other personal protected equipments (PPE).
- All these people are required to pass 'Pulmonary Function Test' and undergo 'Respirator Training' before entering.



OSHA AWARD¹

- In October 2010, OSHA awarded Rice University a grant to "develop and implement a variety of materials and training modules on the safe handling of nanomaterials."
- Dr. Kristen Kulinowski led a multi-university, including both Texas State and UT Tyler, effort to develop this safety-based training program.
- The final results were a series of presentations in various venues to evaluate the effectiveness of the material developed.

¹<http://news.rice.edu/2010/09/29/osha-bolsters-rice-based-safety-program-on-eve-of-buckyball-discovery-conference/>



OSHA COURSE

- The course: “*Introduction to Nanomaterials and Occupational Health.*”
- The focus: Many small companies rely on external consultants to implement workplace safety. Nanomaterials requires specific training.
- The structure: Seven modules that can be taught as either a 4 hour or 8 hour course.
- The implementation: Presentations of the modules at professional conferences demonstrated the need for the 8 hour version.



OSHA COURSE CONTENT

Introduction to Nanomaterials and Occupational Health

Content:

1. Nanotechnology and Nanomaterials
2. What Workers need to know about Nanomaterial Toxicology
3. Assessing Exposure to Nano
4. Controlling Exposure to Nano
5. Risk Management Approaches
6. Regulations and Standards Relevant to Nanomaterial Workplaces
7. Tools and Resources for Further Study



OSHA COURSE CONTENT

- The material developed under this grant (# SH-21008-10-60-F-48) is available on the OSHA web site.
- The course, in the initial development state, was tested at professional conferences. At one conference, the no-charge offering of the course was “sold out” in less than 24 hours.
- The evaluation of the short and long versions of the course revealed that the longer version (8 hours) was preferred by the attendees and yielded a better understanding of the material.



NSF-NUE AWARD

- Texas State wins NSF-NUE (Nanotechnology Undergraduate Education) grant titled “NanoTRA- Texas Regional Alliance to Foster Nanotechnology Environment, Health, and Safety Awareness in Tomorrow's Engineering and Technology Leaders.” This award is for \$199,997 for two years starting from January 1, 2013 and ending December 31, 2014.
- This project will initially impact more than 1,000 undergraduate engineering and technology students at Texas State and UT at Tyler, of which 350 are underrepresented minority students. The insights gained from the development of the courses and the rigorous assessment of learning outcomes will provide the basis for the inclusion of nanotechnology social, ethical, environmental, health, and safety issues in conventional engineering, engineering technology, industrial technology, and science courses.
- The proposed project will help prepare a diverse workforce to supply the needs of emerging nanotechnology companies, over 700 of which are currently based in Texas.



TWO COURSES DEVELOPED

The NSF grant was to develop:

- The first (introductory) course
 - *“Introduction to Nanotechnology Safety”*
 - Consists of 10 modules plus all related course material
- The second (advanced) course
 - *“Principles of Risk Management for Nanoscale Materials”*
 - Also consists of 10 modules and materials



NANOTECHNOLOGY SAFETY

What would you include in
the course content?



INTRO TO NANOTECH SAFETY

1. What is Nanotechnology and Ethics in Nanotechnology
2. Ethics of Science and Technology
3. Societal Impacts
4. Ethical Methods and Processes
5. Nanomaterials and Manufacturing

Notice the emphasis on ethics and societal impacts. The learning needs to cover all aspects of the impact of technology on the world.



INTRO TO NANOTECH SAFETY

6. Environmental Sustainability
7. Nanotechnology in Health and Medicine
8. Military and National Security Implications
9. Nanotechnology Issues in the Future
10. Guest lecturers from Industry and Governmental Agencies & Project presentations

The second half of the Introductory course focuses on the impact potential on environment and health. The material also address developing applications that have health implications.



NANOSCALE RISK MANAGEMENT

1. Overview of Occupational Health & Safety
2. Applications of Nanotechnology
3. Assessing Nanotechnology Health Risks
4. Sustainable Nanotechnology Development
5. Environmental Risk Assessment

The Second course emphasizes the knowledge required to effectively manage the manufacturing and application of nanotechnology in a safe fashion.



NANOSCALE RISK MANAGEMENT

6. Ethical and Legal Aspects of Nanotechnology
7. Developing a Risk Management Program
8. Presentations of Research Projects plus Guest lecturers from various organizations.
9. Hands-on lab efforts in the specially designed lab
10. Corporate visits to leading organizations who are implementing various type of nanotechnology controls.



COURSE #1 INITIAL OFFERING

The University of Texas at Tyler
College of Business and Technology

Department of Human Resource Development and Technology

Course: **TECH 4350** Instructor: Dominick E. Fazarro, Ph.D.
Title: **Special Topics-Introduction to Nanotechnology Safety** Office: 242
Section: 01 Other Availability: by email or appointment
Semester: Summer II-2013 Phone: 903.565.5911
Class Time: ONLINE Email: dfazarro@uttyler.edu

Goal: The goal for this course is to provide technology and engineering students the body of knowledge to enable them to understand the nature of safety of nanomaterials which will impact society.



SUMMARY

- It has taken 10 years to get to the point where the 1st course is ready for offering.
- We knew that we were right on nano safety education. It took persistence for us to gain acceptance. Dr. Tate has demonstrated that.
- The Nanomaterials Application Center aided us in developing nanotechnology capabilities. In 2011, it was transferred from the university to private industry.
- Each of the modules are capable of standing-alone.
- So, are we done? No, we have only started. There are many industries that requires specialized knowledge that we need to incorporate into the courses.



