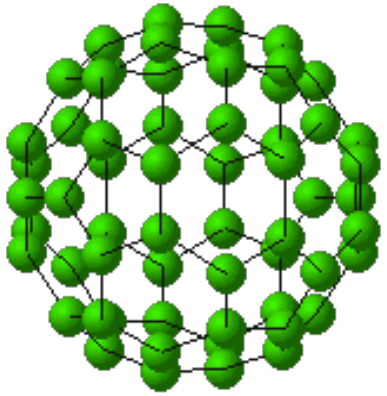
Rice University and the Smalley Institute



Daniel Mittleman
Director, Smalley Institute
February 28, 2012

Smalley Institute
For Nanoscale
Science and Technology
at Rice University

RICE

Rice University

- Independent & Private
- 650 full-time faculty
- 423 part-time and adjunct
- 3485 undergraduates
- 2275 graduate students

David W. Leebron, President

- Ranked among the top five in ‘best value’ by both the Princeton Review and Kiplinger’s
- Ranked number 1 in ‘student happiness’ and ‘quality of life’

Rice – organizational strategy

- Education
  - Schools
    - Science, Engineering, Humanities, Social Sciences, Music, Architecture, Management, Continuing Studies
  - Academic departments
  - Residential environment – highly interactive
- Research
  - Institutes, centers, labs, and groups
  - Highly interdisciplinary
  - Highly collaborative with external institutions

Institutes @ Rice

Richard E. Smalley Institute for Nanoscale Science &Technology
(formerly Center for Nanoscale Science and Technology)

Ken Kennedy Information Technology Institute

Institute for Biosciences and Bioengineering

Rice 360º Institute

Rice Quantum Institute

The Rice Space Institute

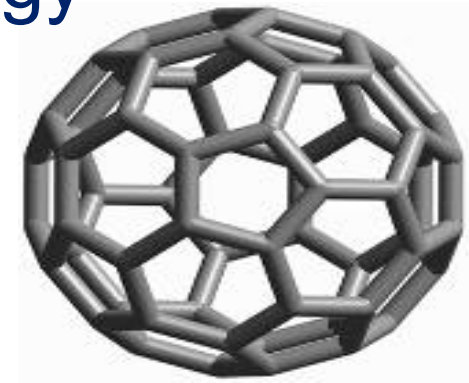
The Baker Institute for Public Policy

Energy and Environmental Systems Institute

Smalley Institute Vision

We lead the world in solving humanity's most pressing problems through the application of nanotechnology.

Richard E. Smalley Institute for Nanoscale Science and Technology



Dell Butcher Hall

- 1993 - Conceived by Prof. Richard Smalley and approved by Board of Governors – 1st in the world
- 1996 – Curl & Smalley win Nobel Prize in Chemistry
- 1997 – New building is dedicated – Dell Butcher Hall
- 2002 – New CNST Director – Wade Adams
- 2005 – Name changed to honor Richard Smalley
- 2012 – New SINST Director – Daniel Mittleman

Smalley Institute

For Nanoscale Science and Technology at Rice University

RICE

Smalley Institute:

A Virtual Organization Across Rice

Advocate Research	External Interactions
Support Faculty	IP, Licensing & Start-ups
Raise Funds	Local - International Meetings
Infrastructure	Symposia
Seminars	Education Outreach
Collaboration	Nanotech Service

150+ faculty members
14 departments

Dan Mittleman, Director
John Marsh, Operations Director
Chris Rodriguez, Accounts Coordinator
Ginny Whitaker, Events Coordinator / NanoFANS
Addy Saenz, Accounting
Stacy Huet, Coordinator (temp)

nano.rice.edu

FOCUS AREAS

- Nano in Energy
- NanoHealth
- NanoMaterials for Aerospace
- Carbon Nanostructures
- NanoPhotonics
- NanoElectronics
- Social/Ethical/ Environmental/ Toxicological Issues
- NanoEducation

Rice is #1 in Materials Science World-Wide

Institution	Papers	Citations	Citations/Paper
1 – Rice University	**381**	**11,949**	**31.36**
2 – Harvard University	596	16,467	27.63
3 – UC Santa Barbara	964	25,376	26.32
4 – University of Washington	822	21,348	25.97
5 – IBM Corporation	573	13,822	24.14
8 – MIT	1,654	34,017	20.57
11 – Stanford University	728	13,853	19.03
13 – Max Plank Society	3,506	54,175	15.45
15 – Georgia Tech	1,581	21,609	13.67
16 – Sandia National Lab	948	12,929	13.64

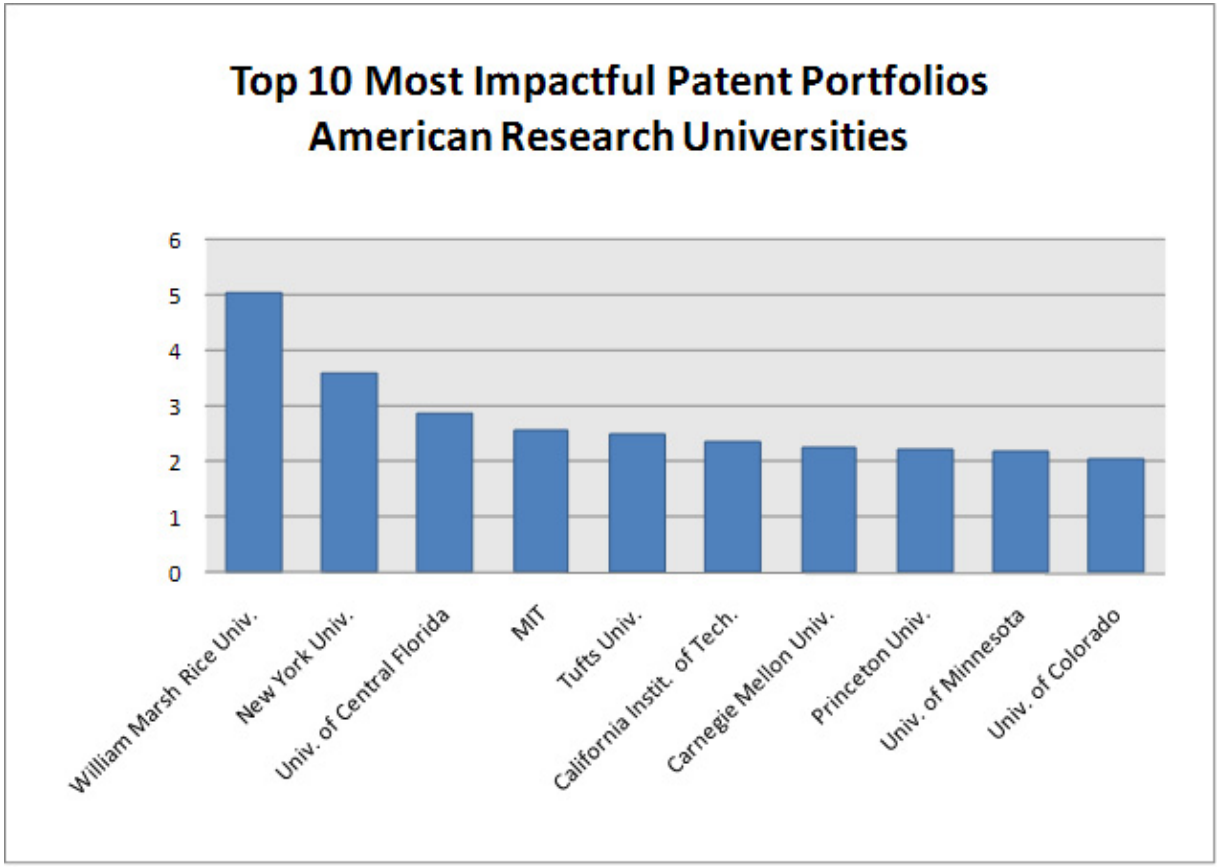
Rice is a Very Innovative Place

Invention Disclosures per $1M research*

Rice	**0.98**		Penn	0.38
Georgia Tech	0.66		U Cal System	0.35
Stanford	0.57		Harvard	0.34
Carnegie Mellon	0.57		UT Austin	0.29
MIT	0.41		Baylor Col. Of Med	0.26
Wisconsin (WARF)	0.40		Texas A&M	0.17

**FY 2008 preliminary AUTM stats*

Rice's patent portfolio has the highest "impact"



Top 10 universities patenting in the United States with the most impactful portfolios measured by The Patent Board Current Impact™ indicator from July 1, 2008 and the previous twelve months. This measure showcases the broader significance of a university's impact on the world technology as compared to all universities. The score indicates the role each university's patents play in serving as a foundation for other patents and technologies.

Smalley Institute

RICE

There have been 42 Rice affiliated start-up companies over the past 10 years (top ten in start-ups/research $)

Carbon Nanotechnologies Incorporated

Unidym

NanoComposites, Inc.

Nanospectra Biosciences

itRobotics

PROMEDIOR
therapeutics to treat fibrosis

OXANE
Nanostructured Innovations

GlycosBio™

natcoretechnology
advancing solar science

1. Advanced Biosciences*- (Matsuda)
2. Advanced Reality* - (Ruths- grad student)
3. **Applied NanoFluorescence- (Weisman)**
4. Aristan Medical - (Athanasiou)
5. **BetaBatt - (Engel)****
6. BI02 Medical**
7. BioCure*
8. BioSonic – (Liebschner)
9. **Cambrios (affiliated company)- (Smalley)**
10. **CNI (now Unidym)- (Smalley, Hauge, et al.)**
11. Desmogen*- (Mikos)
12. **Ensysce Biosciences- (Weisman, Wilson)**
13. Glycos Biotechnology- (Gonzalez)
14. Houston Medical Robotics- (O'Malley)
15. itRobotics- (Ghorbel)**
16. **LabNow**
17. LaserGen (BCM-Metzger; Rice-Curl)
18. Mango Communication*
19. Mass Specific Force- (Weyand)
20. **Molecular Electronics Corp* - (Tour)**
21. MTPE (Museums Teaching Planet Earth) (Reiff)
22. **Nano 3D Biosciences (Killian and Rafael)**
23. **NanoComposites (Tour)****
24. **Nanopartz (Zubarev)**
25. **NanoRidge (Barrera et al.)**
27. **Nanospectra Biosciences (West and Halas)****
28. **NatCore (Barron)**
29. **NewCyte (Barron)**
30. OrthoAccel**
31. **Oxane Materials (Barron)**
32. ProMedior (Gomer)
33. Semmt**
34. **Smart Imaging Technology****
35. **Solterra (Wong)**
45. Somatogen* -(Olson)
46. Stellarray**
47. Trellis* (affiliated company)- (Gomer)
48. **Vanguard Solar – (Barron)**
49. Xilas Medical (affiliated company)- (Athanasiou)
50. InView Tech – Bob Bridge (Baraniuk)
51. **Rebellion Photonics**
52. OrthoIntrinsics

BioSonic®

NanoRidge

VANGUARD SOLAR
BRINGING SOLAR ENERGY DOWN TO EARTH

* *Inactive* ** *9 have received funding from Texas Emerging Technology Fund* **Bold: 19 are Nano-related**

U. S. Air Force Research Laboratory
University of Texas - Dallas
University of Texas - Austin
University of Texas - Arlington
University of Texas - Pan American
University of Texas - Brownsville
University of Houston
Rice University

CONTACT

Nanotechnology for the Air Force, Aerospace, and Commerce

2008 – 2012

Jack Agee
Executive Director, **CONTACT Program**

Consortium for Nanomaterials for Aerospace Commerce and Technology

CONTACT
Project Description

1. **Adaptive Coatings and Surface Engineering**
   - Nano coatings (reduce drag, corrosion,repair cracks)
   - Thermal control, space environment resistant satellites
   - Nanoparticle enhanced composites – structures
2. **Nano Energetics**
   - High energy propellants and explosives
   - Use nanoparticles to control the burn rate
3. **Electromagnetic Sensors**
   - Devices for optical sensing, communications
   - Ultraviolet, visible, infra-red, terahertz frequencies
4. **Power Generation and Storage**
   - Solar cells, magnets, next generation batteries, capacitors
   - Enable directed energy weapons, compact power generators

Nanotechnology short courses for Lockheed Martin engineers

LANCER
Lockheed Martin Advanced Nanotechnology Center of Excellence at Rice University

	Monday, January 9	Tuesday, January 10	Wednesday, January 11	Thursday, January 12	Friday, January 13
8:30-9:30	Fundamentals of Nano I	Nanomaterials II	Fullerenes II	Nanoelectronics I	Sensors
	Jim Tour	*Doug Natelson*	*Jim Tour*	*Doug Natelson*	*Vicki Colvin*
9:30-10:30	Fundamentals of Nano II	Nanomaterials II - Top down contd.	Properties	Nanoelectronics II	Nanomaterials IV
	Doug Natelson	*Doug Natelson*	*Howard Schmidt*	*Doug Natelson*	*Brian Korgel - UT*
10:30-10:45	BREAK				
10:45-11:45	Tools I - Microscopy	Nanomaterials III - Bottom up	Properties of nanomaterials	Nanoelectronics III	Sensors - Systems aspects
	Jason Hafner	*Vicki Colvin*	*Boris Yakobson*	*Ananth Dodabalapur - UT*	*Richard Baraniuk*
11:45 - 1:00 LUNCH	Quantum computation - Jun Kono	Visit SEA Labs for Processing demo - Vicki Colvin	Lab tour CNL - Howard Schmidt	Future of Nano - Kristen Kulinowski	History NNI - Neal Lane
1:00-2:00	Tools II - Spectroscopy	Nanomaterials V - Self assembly I	Materials applications	Nanoelectronics IV	Panel Discussions
	Valeria Moore	*Jeff Hartgerink*	*Howard Schmidt*	*Jim Tour*	*Brian Korgel, Richard Baraniuk, Vicki Colvin*
2:00-3:00	Tools III - Surface science	Nanomaterials VI - Self assembly II	Composites I	Photonics I	
	Kevin Kelly	*Jeff Hartgerink*	*Rick Barrera*	*Dan Mittleman*	
3:00 -3:15	BREAK				
3:15-4:15	Nanomaterials I	Fullerenes I	Composites - II	Photonics II	
	Vicki Colvin	*Bob Hauge*	*Rick Barrera*	*Dan Mittleman*	
4:15-5:00	Travel time to the Hotel				
5:00-6:00	Panel Discussions over dinner at the Hilton Houston Plaza				
	Vicki Colvin, Kevin Kelly, Matteo Pasquale	*Rick Barrera, Andy Barron*	*Rick Barrera, Bob Hauge, Howard Schmidt*	*Ananth Dodabalapur, Doug Natelson, Jim Tour and Dan Mittleman*	

- A week-long **Short Course** at Rice – Intro to Nanoscience and Nanoengineering
- Enthusiastic response after the first course (2005) inspired repeat performances.
- Interactions between LM personnel and Rice faculty germinated the idea for LANCER

Smalley Institute

RICE

LANCER

Lockheed Martin Advanced Nanotechnology Center of Excellence at Rice University

LOCKHEED MARTIN

We never forget who we're working for®

Richard E. Smalley Institute For Nanoscale Science and Technology at Rice University

RICE Unconventional Wisdom

Lockheed Martin Advanced Nanotechnology Center of Excellence at Rice University

Daniel Mittleman
Faculty Director

Gigi Semine
Administrative Assistant

- Joint oversight committee: Rice and LM personnel
- Rice-LM agreements in place
  - blanket NDA covers all Nanotechnology and all of the Smalley Institute
  - a framework for handling issues of IP, ITAR
  - it is easy to add projects from any LM unit

RICE

Shared Equipment Authority

www.sea.rice.edu

Shared Equipment Authority

The SEA provides campus-wide oversight of shared equipment planning and administration, raises federal and private funds for shared equipment acquisition and maintenance, and revises institutional policy on cost centers to more efficiently manage shared research equipment.

Professor Doug Natelson, Dr. Wade Adams, Co-Chairs

Professor Vicki Colvin, Founding Chair

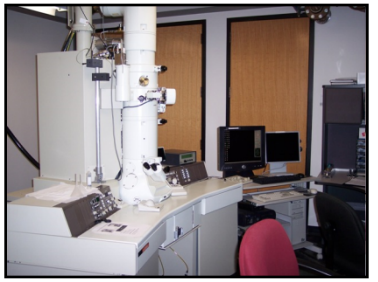
CBEN

Center for Biological and Environmental Nanotechnology

Shared Equipment Authority

Shared Equipment Authority

sea.rice.edu



- Manages shared equipment on campus
- Now supports over 80 instruments
  - Full spectrum of equipment – TEM, SEM, AFM, NMR, etc.
  - Facilities – X-ray, mass spec, clean room
- Many external users, simple authorization process
  - Pay fair fees for usage
  - Expert operator time extra, if needed
  - Model for NSF, Texas Virtual Lab

Terahertz imaging

- Science and technology of the far infrared
- Photon energy: a few meV (not MeV!)
- The least well developed region of the electromagnetic spectrum
- Possible applications: non-destructive evaluation, security, etc.