Graduate School at BYU

Graduate School Information Dinner

October 17, 2013

Some Facts

- Program Size
  - 15 full time faculty members, around 3 students per faculty
  - 35 PhD students
  - 12 MS students
- Entrance Requirements
  - 3.0 GPA in upper division ChE classes and 3.3 overall GPA
  - GRE general exam (must do well on Quantitative section)
  - 3 letters of recommendation—research experience is a plus
  - Fall application deadline: Feb. 15 (apply in January, or earlier)
- Financial Aid
  - Tuition
    - Ph.D.—Department and advisor pay most tuition costs
    - M.S.—Pay own tuition
  - Stipend for students making good progress
    - $23,000/yr for PhD, $22,000/yr for MS
  - Many competitive fellowships available
    - NSF, DOD, DOE, EPA, NASA, Hertz, ExxonMobil, etc.

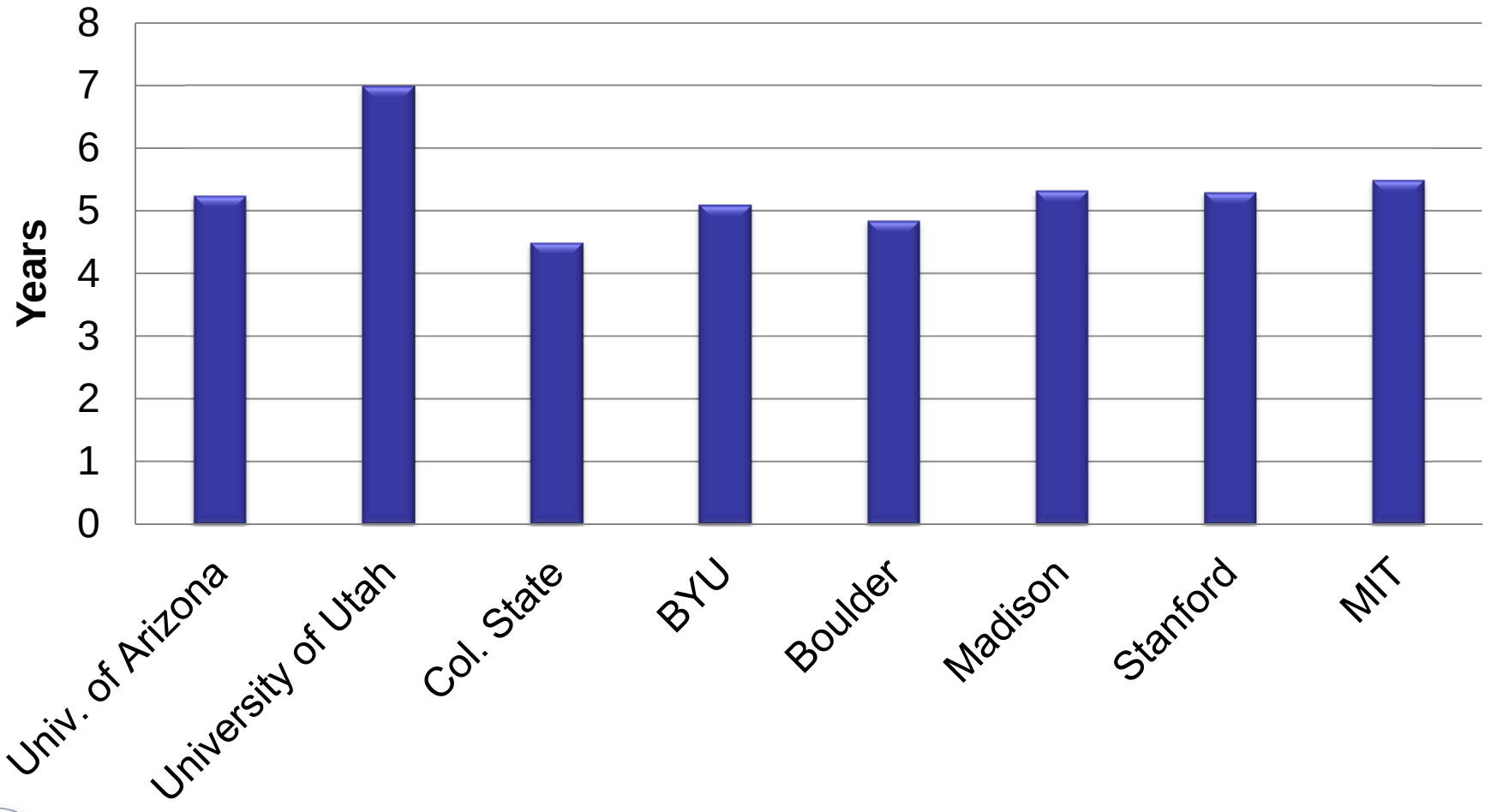
Some Facts

- Select and work with an advisor
- M.S. Requirements
  - 30 credit hours = 23 lecture hours + 7 seminar/research
    - 8 regular classes (4 required)
  - TA for 1 semester (10 hrs/wk)
  - Publish 1 scientific paper,
    - Contributes to thesis
  - Target completion = 2 years
- Ph.D. Requirements
  - 54 credit hours = 34 lecture hours + 20 seminar/research
    - 12 classes (4 required)
  - TA for 2 semesters (10 hrs/wk)
  - Publish 3 scientific papers
    - Contributes to dissertation
  - Target completion = 4 years

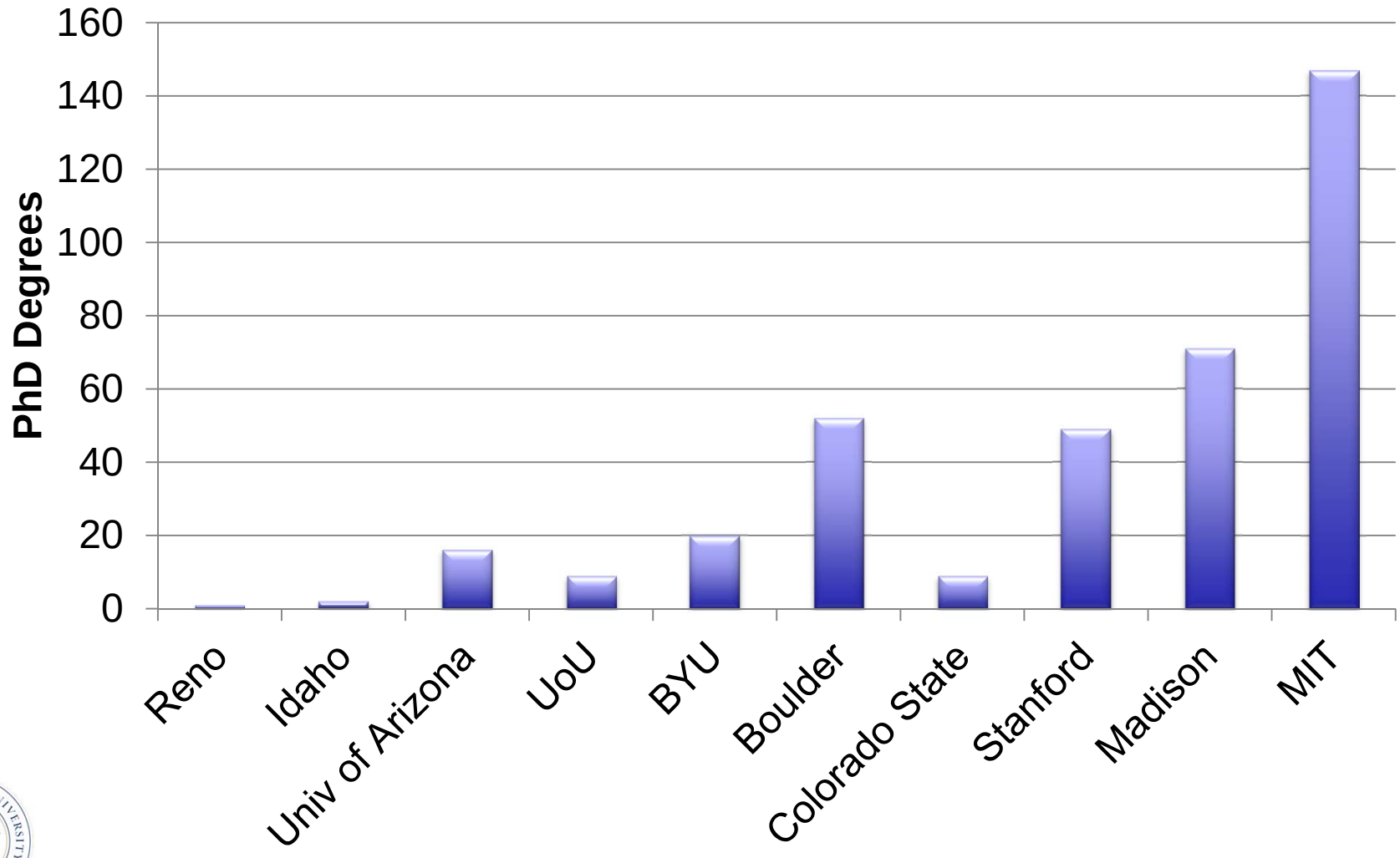
Why BYU ChemE?

- Active Research Programs
  - DIPPR
  - Combustion and energy
  - Biomedical engineering
  - Catalysis
  - Biochemical and molecular simulation
  - Electrochemical
  - ~$250,000/faculty per year for research
- Nearly all students in the program are funded
- Faculty are devoted to the students

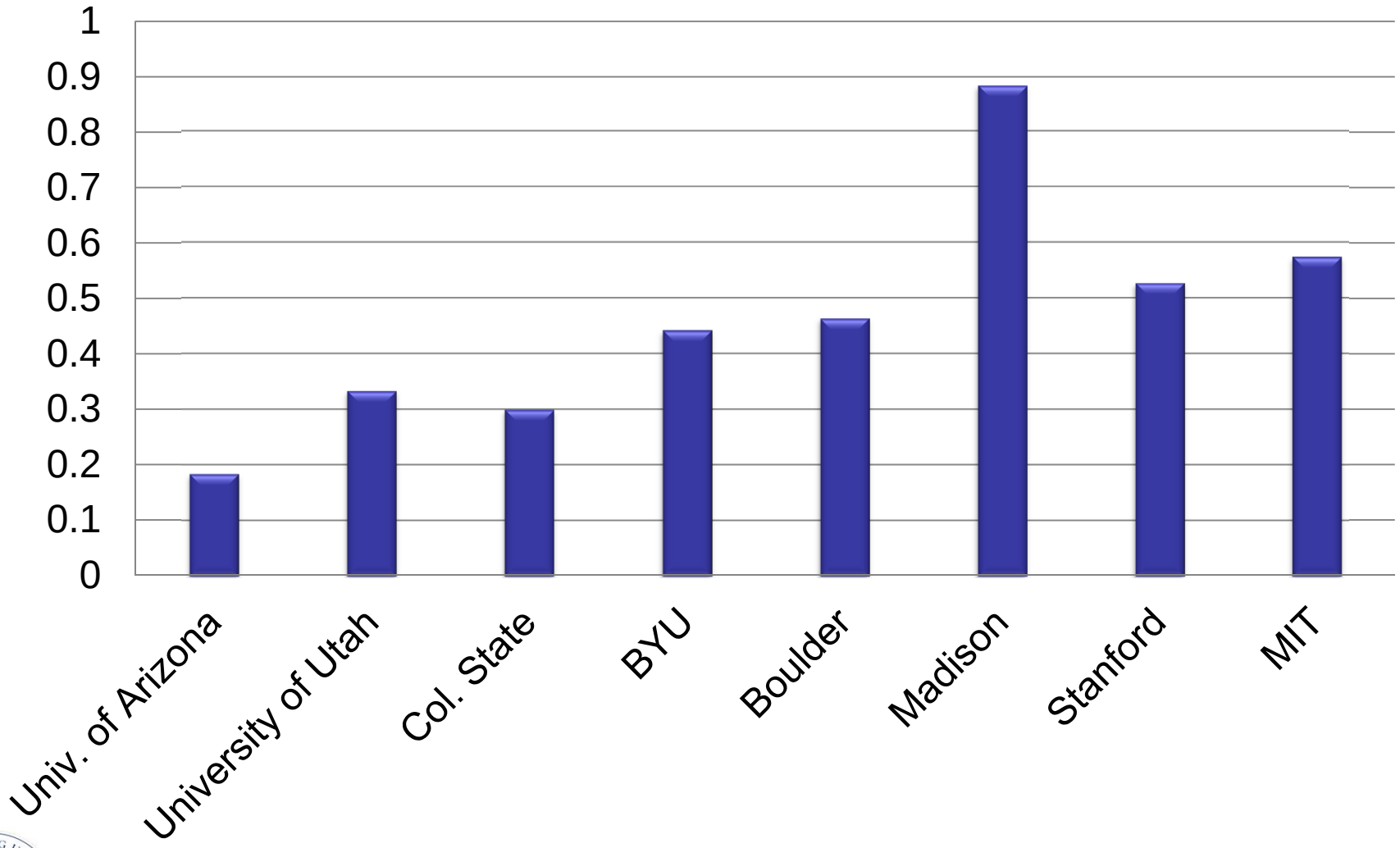
Time Commitment



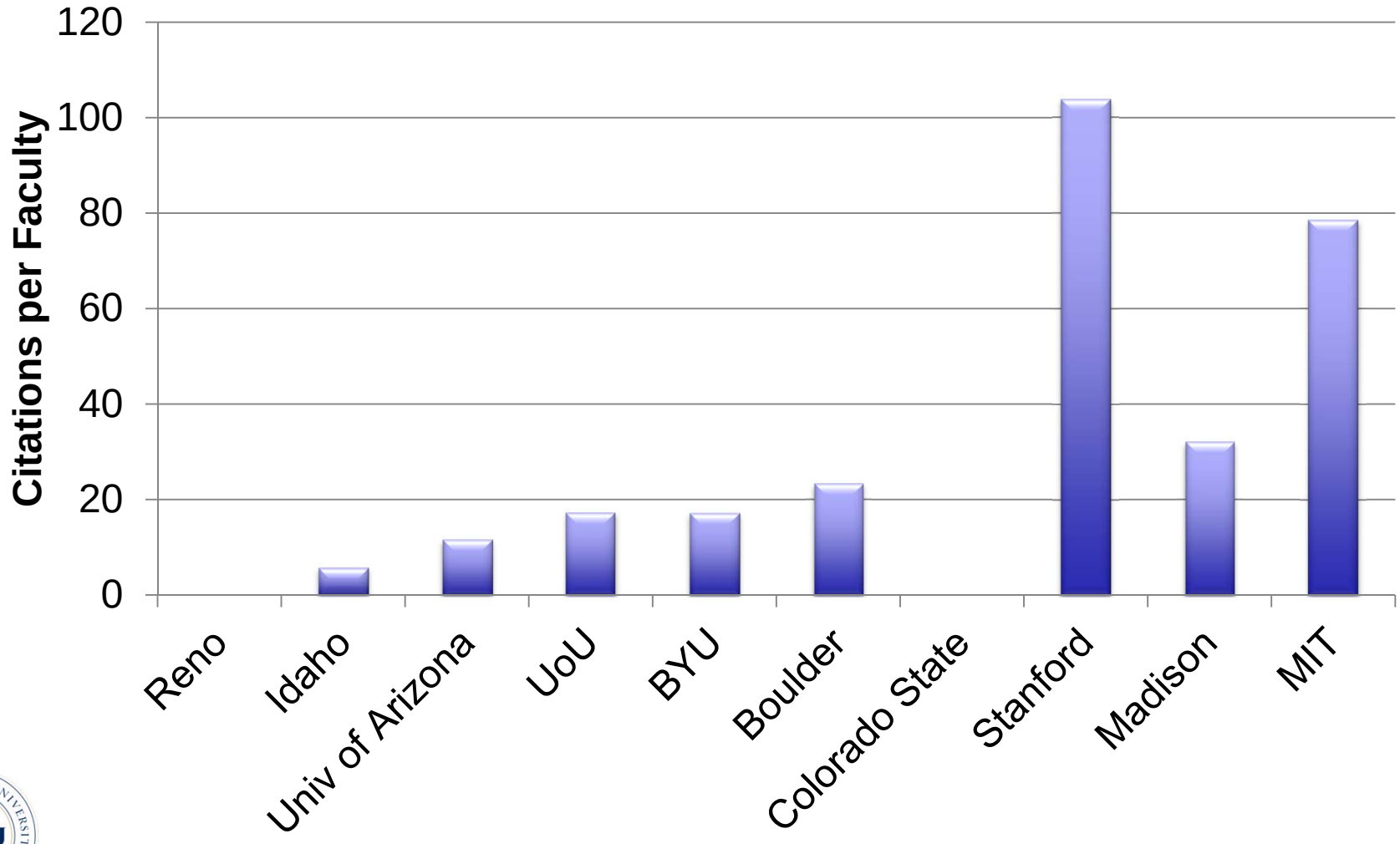
PhD Degrees (2000-2004)



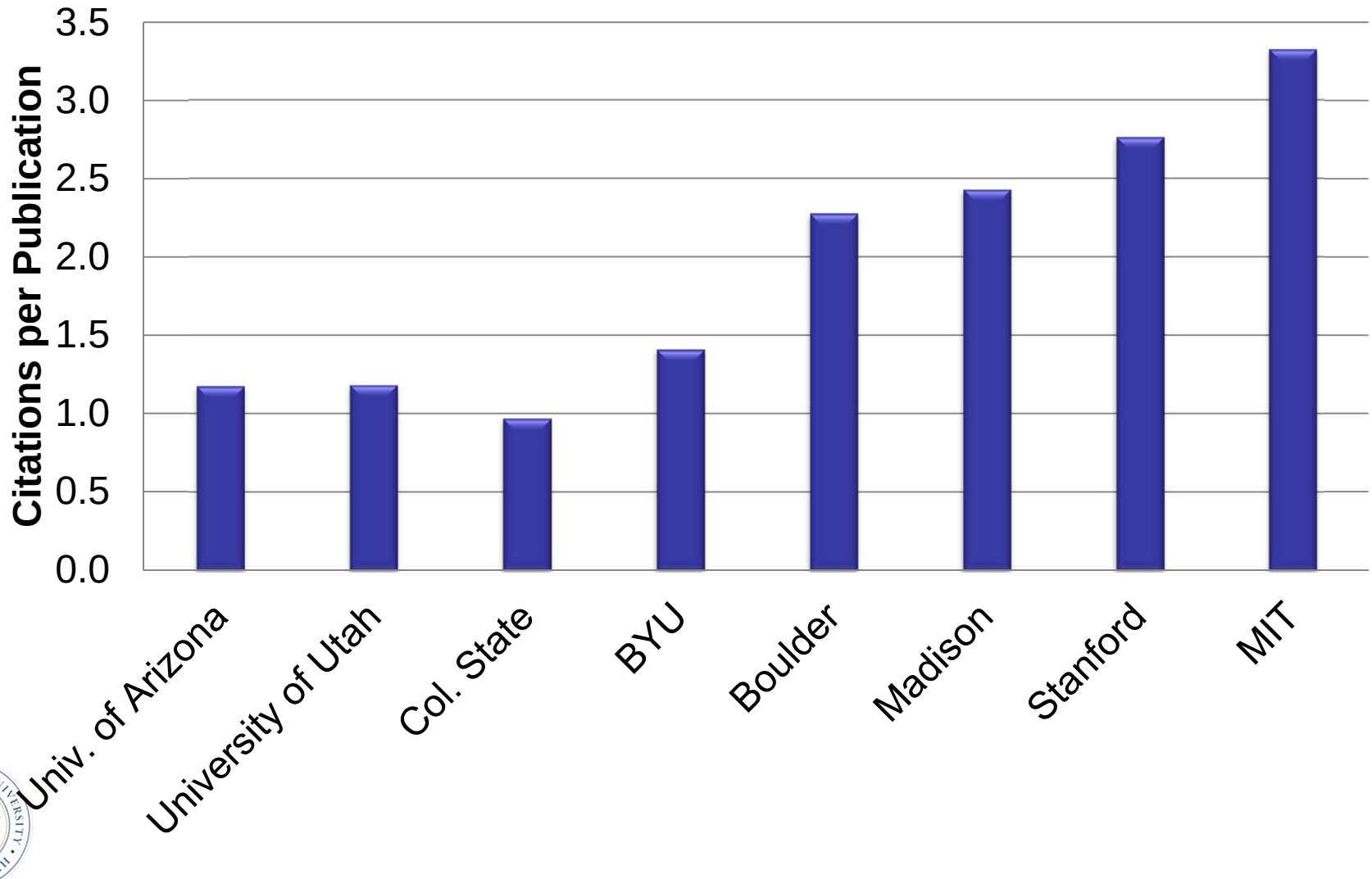
PhD Degrees per Faculty per Year



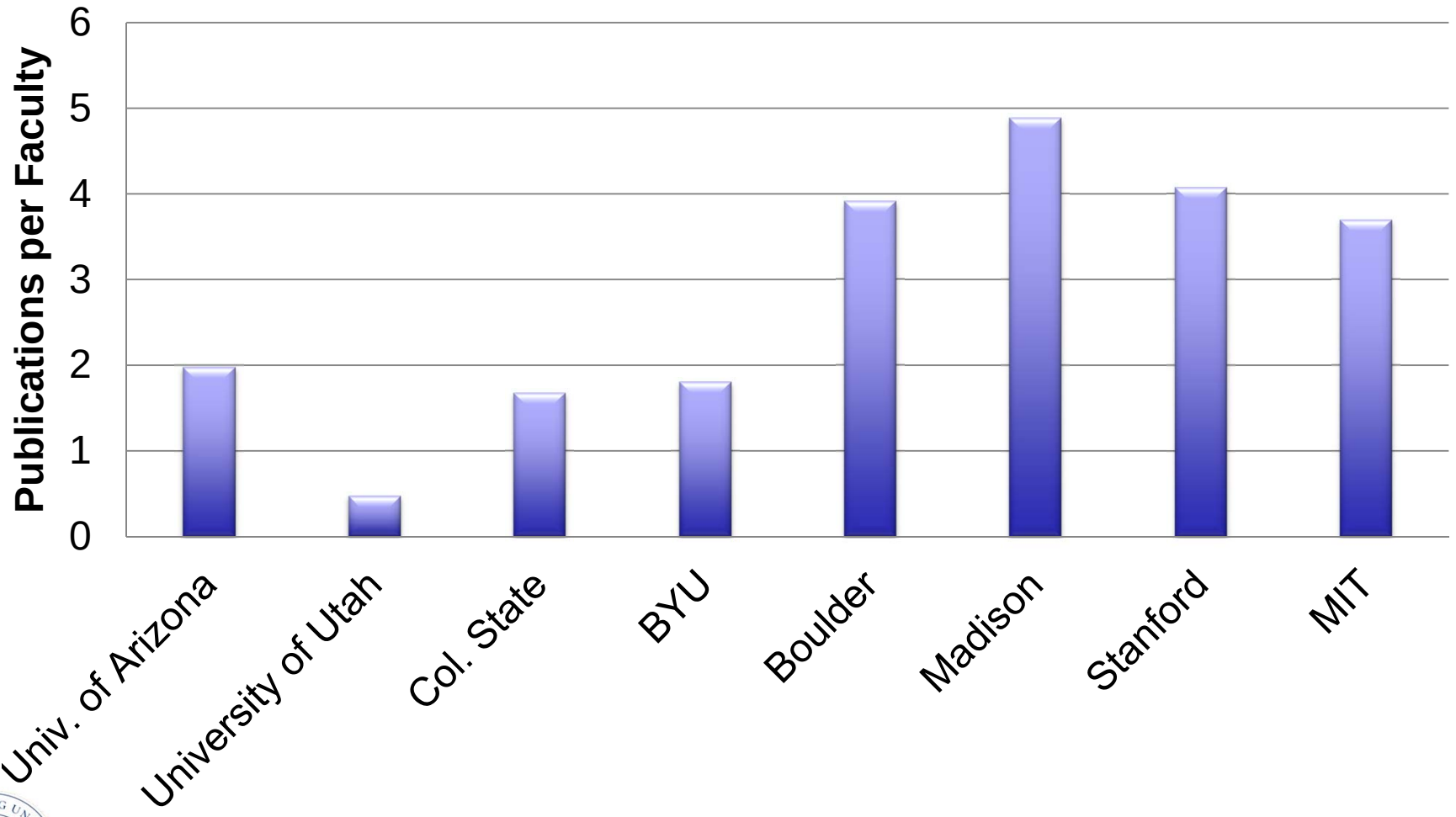
Citations


Citations per Faculty
120
100
80
60
40
20
0
Reno
Idaho
Univ of Arizona
UoU
BYU
Boulder
Colorado State
Stanford
Madison
MIT

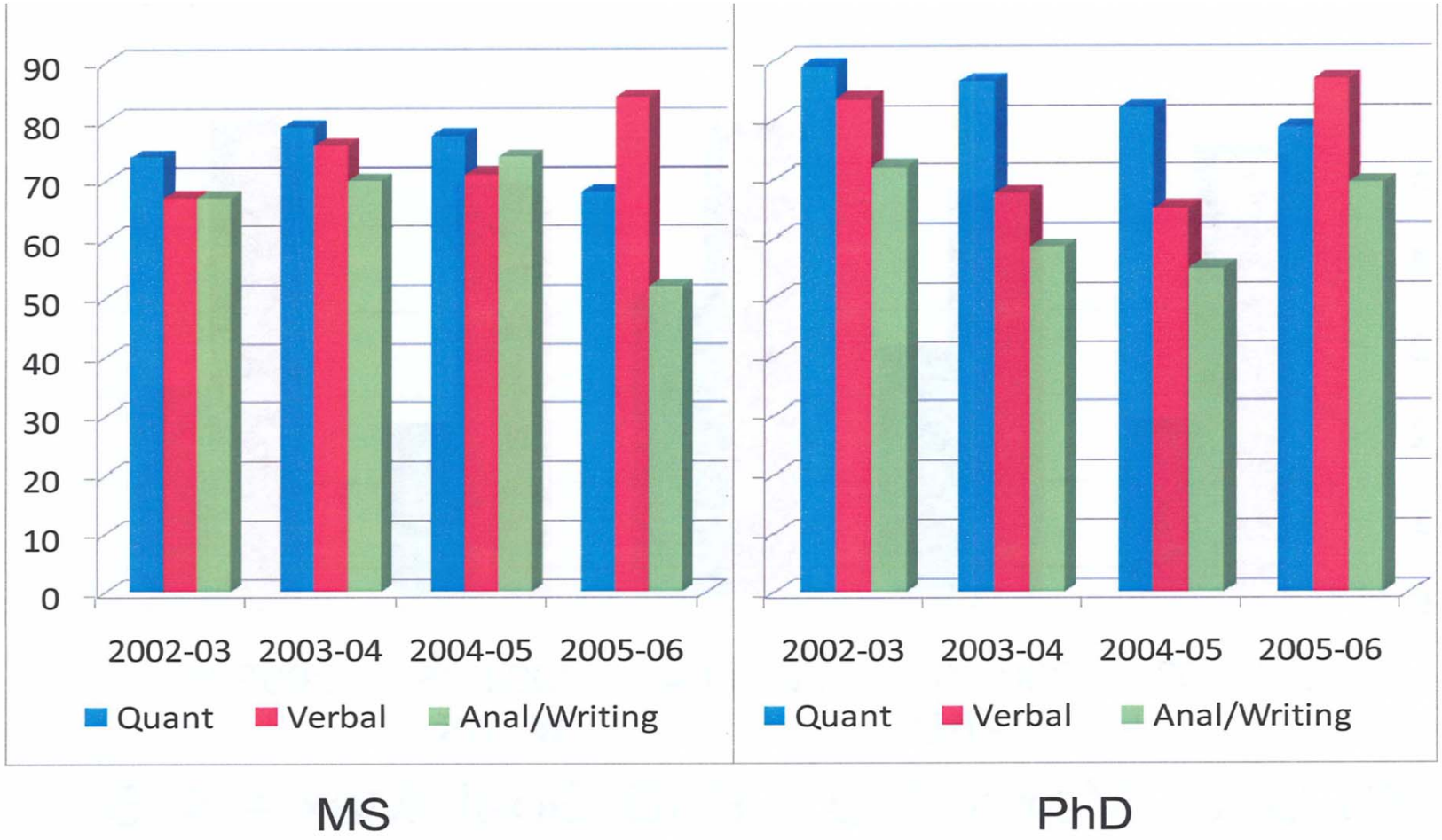
Quality Research (Citations/Paper)



Publications

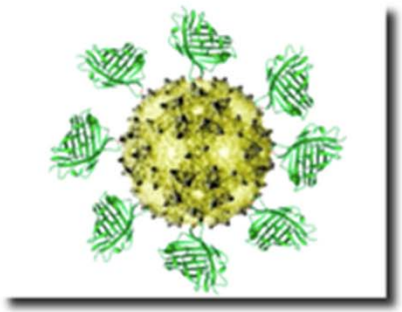


Quality Graduate Students

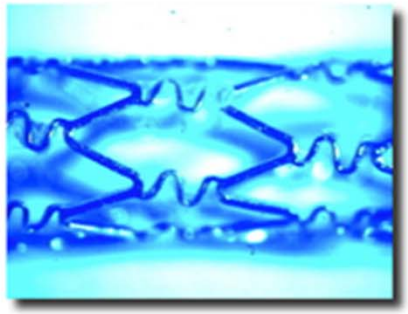


GRE Percentiles

BYU Research Areas



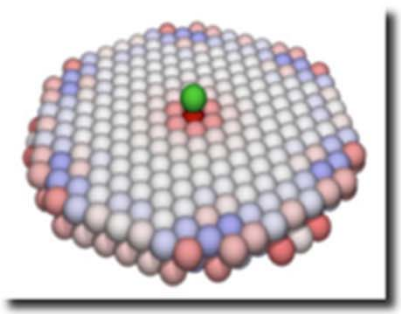
Biochemical Engineering



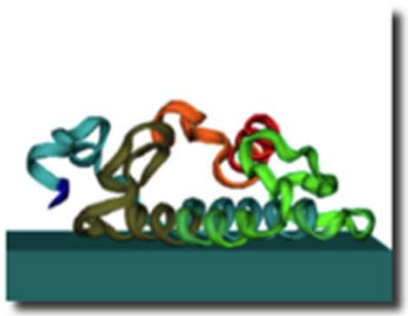
Biomedical Engineering

Catalysis

Combustion

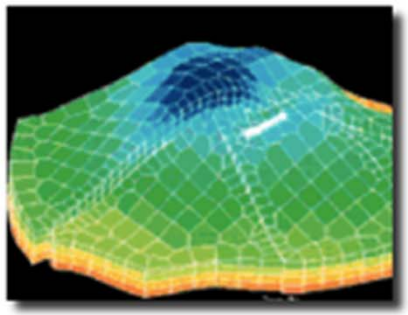


Electrochemical Systems

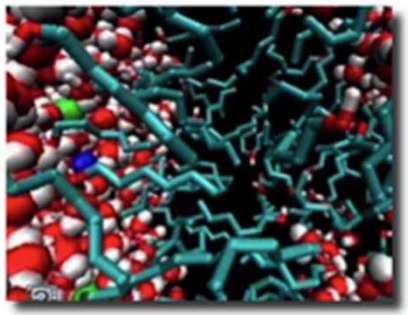


Molecular Simulations

Sustainable Energy



The International Reservoir Simulation Research Institute

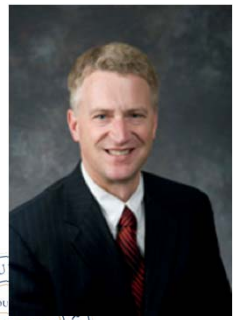


Thermophysical Properties

Biochemical Engineering / Simulations

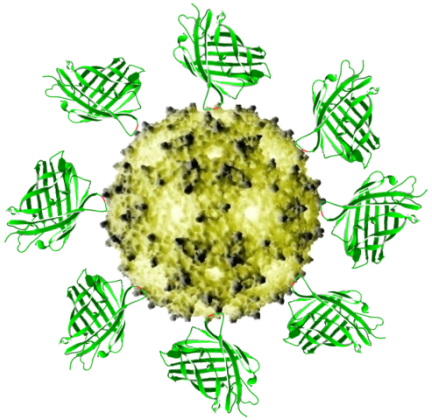
Brad Bundy

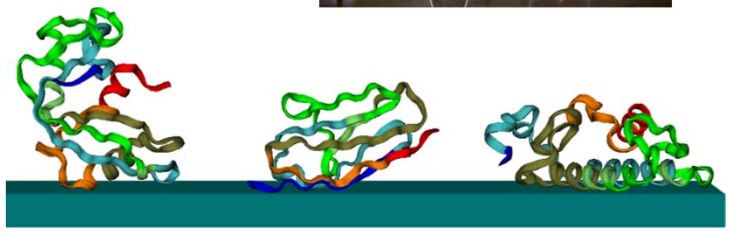
Thomas Knotts



Randy Lewis

- Kinetic modeling of bioprocesses including fermentation
- Production of fuel and other products from biomass
- Expanding the language of biology with unnatural amino acids
- Inventing new vaccines with virus-like particles
- Simulations of biomolecular systems (biosensors, DNA/protein micro-arrays)

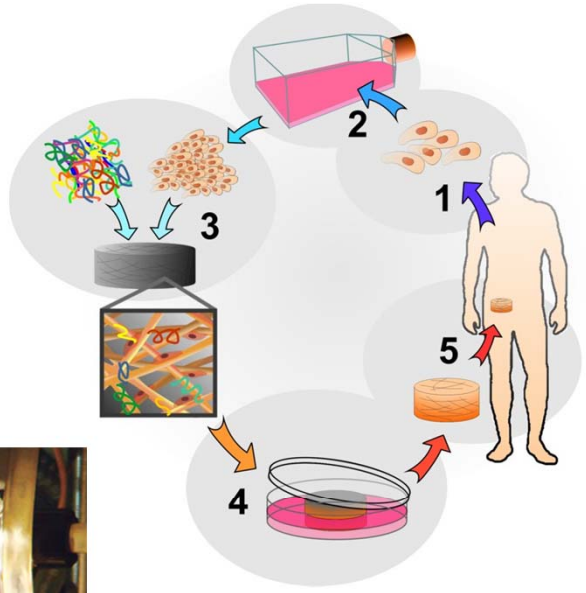




Biomedical/Tissue Engineering

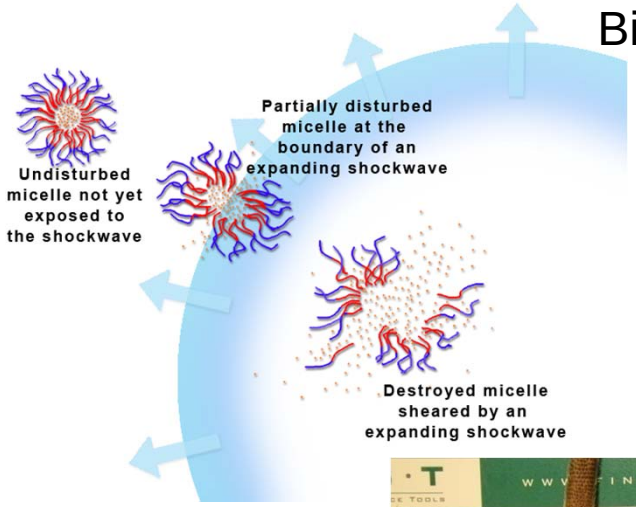
Lon Cook

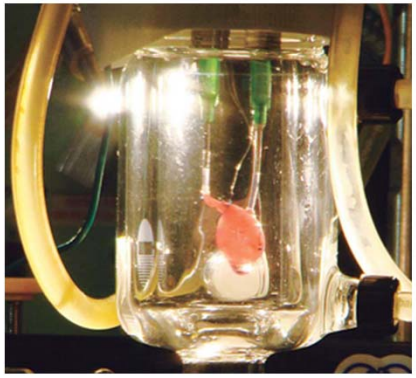
Tissue Engineering



Ultrasonic Drug & Gene Delivery

Bill Pitt





Growing Hearts in a Bioreactor

Human Ear on Back of Mouse

Chemotherapy

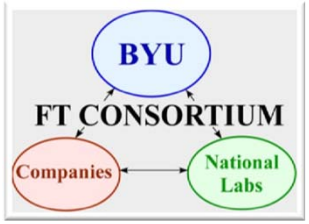
Catalysis and Kinetics

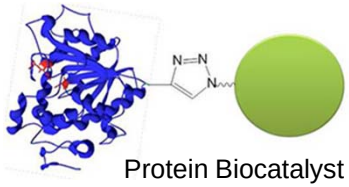
Bill Hecker

Morris Argyle

Brad Bundy

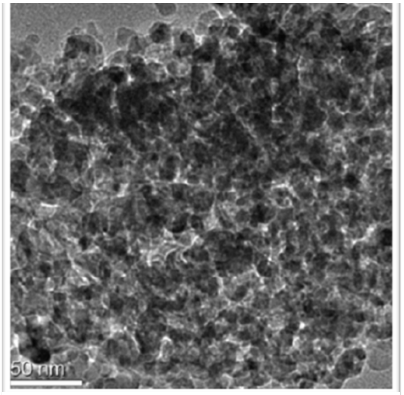
- Preparation, characterization, and testing of sophisticated nanomaterials
- Detailed kinetic measurements and kinetic modeling of catalytic reactions
- Reactor design and optimization
- Current research includes Fischer-Tropsch synthesis and water-gas shift catalysts
- Biocatalysis optimization/immobilization





Protein Biocatalyst

Preparation of FT Cobalt Catalyst



TEM image of FT Fe Catalyst

Fixed-Bed Reactor System

Combustion

Tom Fletcher

David Lignell

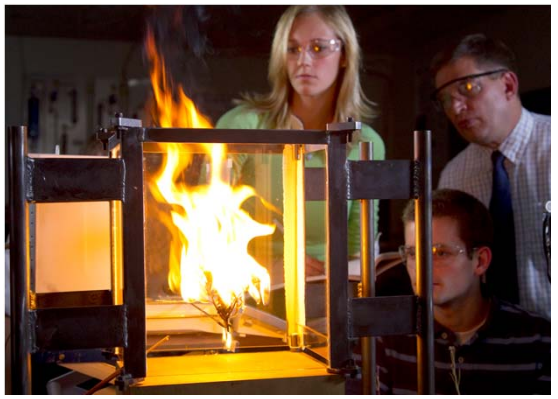
Larry Baxter

85% of world's energy comes from fossil fuels!

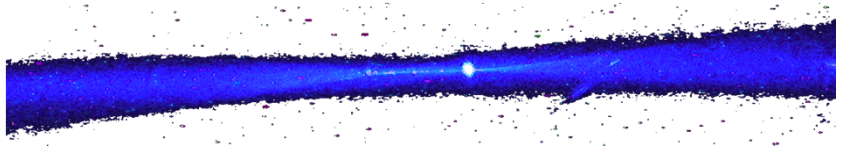
- Clean coal, oil shale, and biomass energy conversion
- Exa-scale simulation advanced industrial-scale coal-fired boiler
- Advanced turbulent reacting flow simulation approaches: ODT/DNS/LES
- Advanced diagnostics for combustion and gasification
- Ignition conditions of wildland fires
- Biomass combustion/gasification and co-firing

Oil shale

Wildland fires



ODT and DNS



Particle suspended on laser

Electrochemical Systems

Dean Wheeler

John Harb

- 3D modeling for the development of next generation devices and the mitigation of technology limiting factors
- Fabrication and optimization of high-performance electrodes and batteries
- Advanced diagnostic techniques for electrochemical devices
- Nano-scale device fabrication with use of self-assembling biological templates

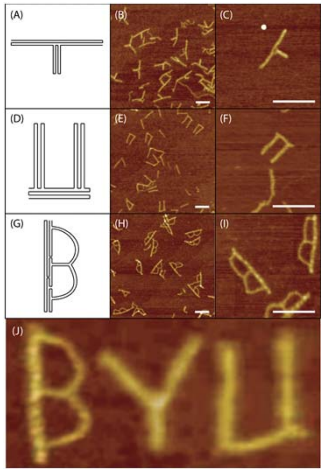
Honey, I shrunk the battery

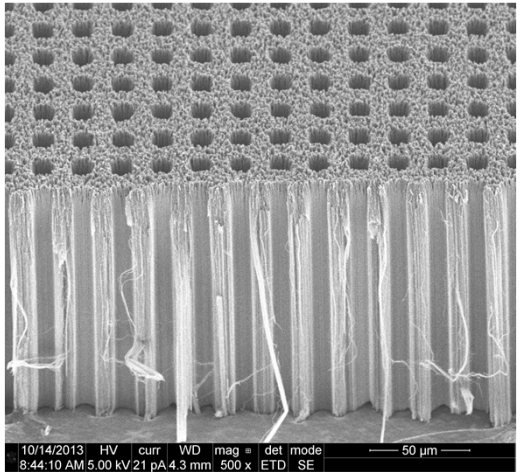
BY DAN NAILEN
THE SALT LAKE TRIBUNE

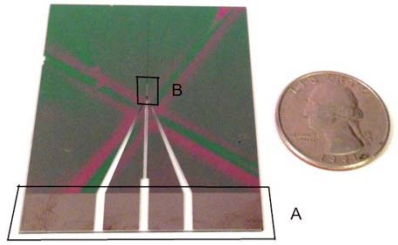
Computer researchers are not only building better gadgets as technology advances, but making them smaller, faster and cheaper.

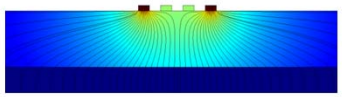
Microelectromechanical systems, or MEMS, have dominated the work of many researchers and engineers in recent years. MEMS are a series of miniature electronic structures and sensors integrated on one silicon chip. They range in size from less than one inch to a micron — one-thousandth the thickness of a nickel.

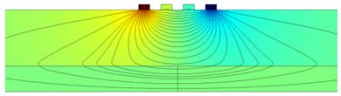
MEMS are not only compact, but usually are more precise than older systems due to the close proximity of their parts. They are already used commercially in automobile air bags, with a tiny MEMS sensor







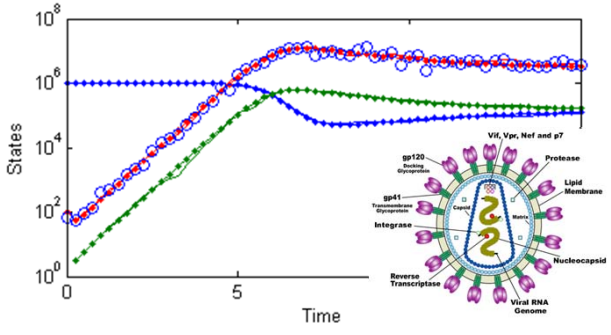


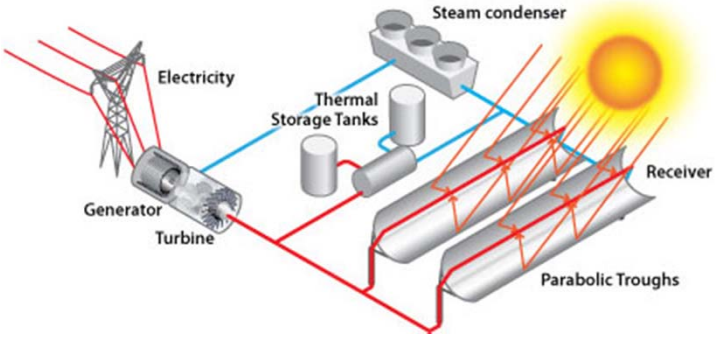


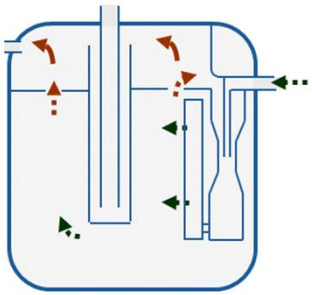
Process Control and Optimization

John Hedengren

- Energy Systems
- Computational Biology
- Upstream Oil & Gas
- Optimization Technology
  - Nonlinear Programming
  - Mixed Integer Systems
- Graduate Internships







Sustainable Energy

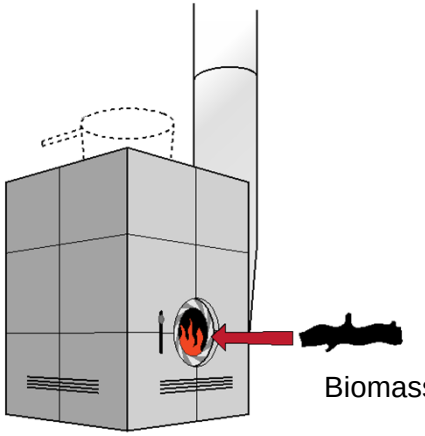
Larry Baxter

Randy Lewis

- Carbon capture process capable of CO_2 capture at 2-3 ¢/kwh – less than half of other systems
- Large, efficient, rapidly responding energy storage processes
- Biomass thermal and biological conversion to useful energy
- Advanced diagnostics for combustion and gasification
- Energy for developing countries

Cryogenic Carbon Capture™ Hardware

Syngas conversion to biofuels and chemicals



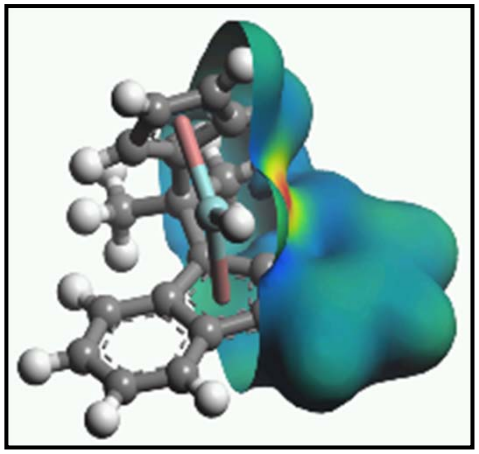
Biomass cookstove development

Thermophysical Properties

Vincent Wilding

Tommy Knotts

- Thermophysical property measurement and estimation
- Development and management of DIPPR database of properties of industrially important chemicals
- Molecular simulations and quantum chemical calculations



DIPPR

DIPPR ID: 1478
Formula: C4H4O
Synonyms:
DIVINYLENE OXIDE
FURANE
FURFURAN
FURFURANE
OXACYCLOPENTADIENE
OXOLE
TETROLE

Chem Abstract Name: FURAN
Structure -CHCHCHCHO-
SMILES Formula: C1=COC=C1

Accepted

Property	Value	Units	Ref	Notes	Data Type	Uncertainty
Molecular Weight	68.074	kg/kmol	1	1017		
Critical Temperature	490.15	K	38		Experimental	< 1%
Critical Pressure	5.5000E+06	Pa	38		Experimental	< 3%
Critical Volume	0.218	m³/kmol	38		Experimental	< 5%
Critical Compressibility Factor	0.294		0		Defined	None
Melting Point	187.55	K	1379		Experimental	< 0.2%
Triple Point Temperature	187.55	K	1379		Experimental	< 0.2%
Triple Point Pressure	50.026	Pa	0		Predicted	< 3%
Normal Boiling Point	304.5	K	31		Experimental	< 3%
Liquid Molar Volume	0.073109	m³/kmol	0		Experimental	< 1%
Ideal Gas Heat of Formation	-3.4800E+07	J/kmol	471		Experimental	< 3%
IG Gibbs E of Formation	8.2250E+05	J/kmol	0	149	Defined	< 3%
Ideal Gas Absolute Entropy	2.6714E+05	J/kmol·K	2577		Experimental	< 3%
Std Heat of Formation	-6.2600E+07	J/kmol	1379		Experimental	< 3%
Std Gibbs E of Formation	-1.8810E+04	J/kmol	0	2920	Defined	< 5%
Std Absolute Entropy	1.7670E+05	J/kmol·K	0	2986	Predicted	< 5%
Heat of Fusion at MP	3.8030E+06	J/kmol	31		Experimental	< 1%
Heat of Combustion	-1.3959E+09	J/kmol	400		Experimental	< 3%
Acentric Factor	0.201538		0		Defined	None
Radius of Gyration	2.5590E-10	m	1112		Defined	< 3%

How To Prepare for Graduate School

- GRE exam
  - Study: especially the verbal and analytical sections
  - Can take online, Take early
- Application
  - January application deadlines (vary by university)
  - Letters of recommendation, written statements, transcripts.
- Can take grad classes as an undergrad
  - prepare for grad school somewhere else,
  - early start on research
- Integrated Masters Program

Conclusions

- Graduate work is rewarding and provides many opportunities
- Many important and interesting research areas in Chemical Engineering
- BYU Chemical Engineering is a great choice!