NANOTECHNOLOGY RESEARCH AT THE NATIONAL INSTITUTES OF HEALTH

Jeffery A. Schloss, Ph.D.
Program Director,
Technology Development Coordination
National Human Genome Research Institute, NIH

DOE Nanoscale Science Research Centers Workshop
Agency Session
February 27, 2003

NHGRI

Mission: To uncover new knowledge...
...that will lead to better health for everyone;
...to help prevent, detect, diagnose, and treat disease and disability.

NIH BIOENGINEERING CONSORTIUM (BECON)

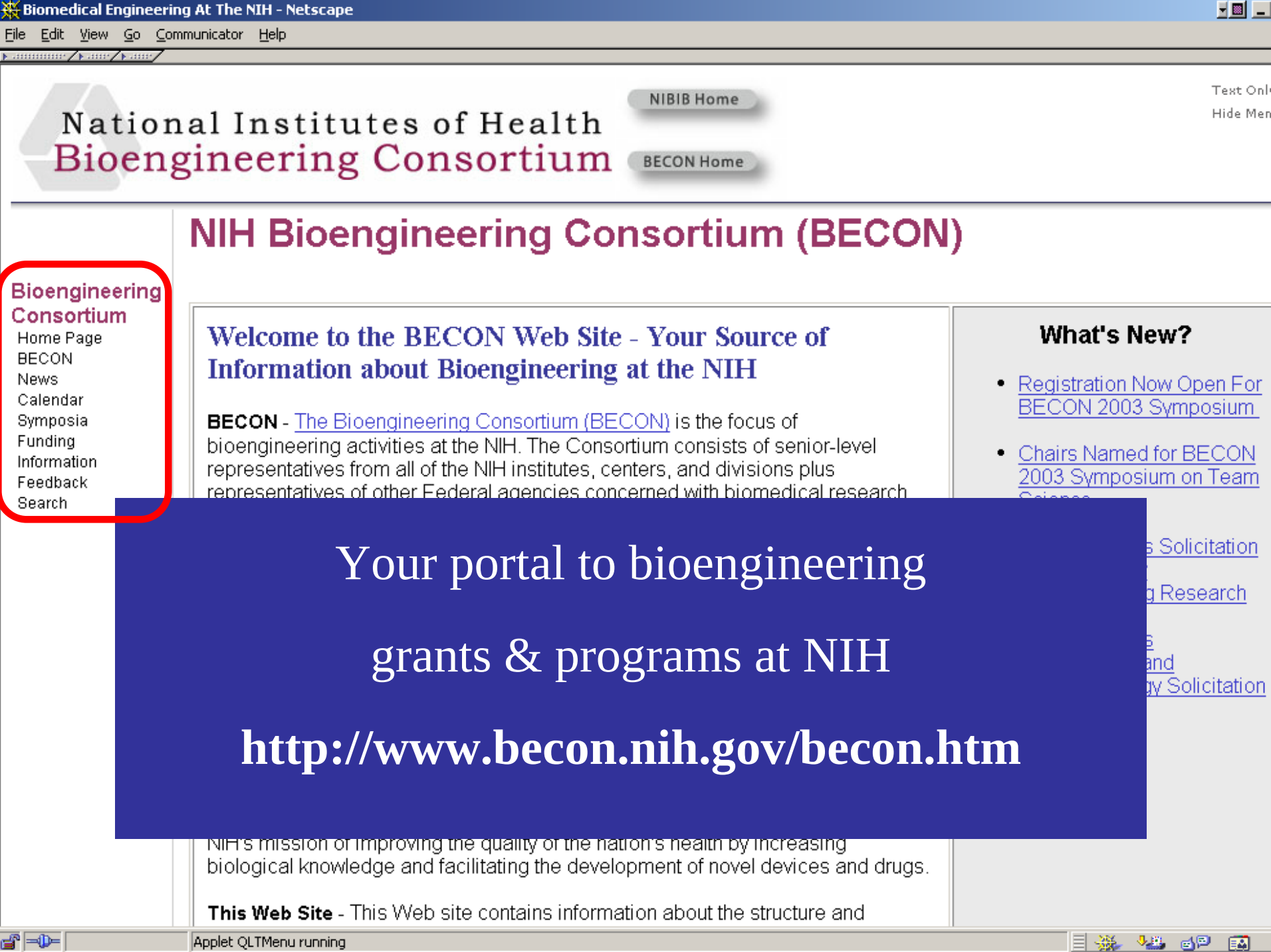
Nanotechnology programs at NIH are coordinated through the Bioengineering Consortium (BECON)

- Initiated in February 1997 by Office of the Director, NIH
- Aimed at facilitating development of bioengineering and fostering intra-NIH and inter-agency cooperation
- Multi-agency membership. Members consist of senior-level representatives from NIH institutes, offices and centers and other federal agencies

NIH BIOENGINEERING CONSORTIUM (BECON)

BECON MEMBERS

NIH-OER	NCRR	NIAMS	NIEHS
NIH-CSR	NEI	NIBIB	NIGMS
NIH-OIR	NHGRI	NICHD	NIMH
NIH-CC	NHLBI	NIDA	NINDS
NIH-ORS	NIA	NIDCD	NINR
NIH-CIT	NIAAA	NIDCR	NLM
NCI	NIAID	NIDDK	*DOE NSF NIST*


Biomedical Engineering At The NIH - Netscape
File Edit View Go Communicator Help
National Institutes of Health
Bioengineering Consortium
NIBIB Home
BECON Home
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NIH Bioengineering Consortium (BECON)
Bioengineering Consortium
Home Page
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News
Calendar
Symposia
Funding
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Welcome to the BECON Web Site - Your Source of Information about Bioengineering at the NIH
BECON - The Bioengineering Consortium (BECON) is the focus of bioengineering activities at the NIH. The Consortium consists of senior-level representatives from all of the NIH institutes, centers, and divisions plus representatives of other Federal agencies concerned with biomedical research
What's New?
Registration Now Open For BECON 2003 Symposium
Chairs Named for BECON 2003 Symposium on Team
Your portal to bioengineering
grants & programs at NIH
http://www.becon.nih.gov/becon.htm
NIH's mission of improving the quality of the nation's health by increasing biological knowledge and facilitating the development of novel devices and drugs.
This Web Site - This Web site contains information about the structure and
Applet QLTMenu running

Department of Health & Human Services
NATIONAL INSTITUTES OF HEALTH
National Institute of Biomedical Imaging and Bioengineering

NIBIB Home **NIH Home**

Welcome to the Web Site for the
National Institute of Biomedical Imaging and Bioengineering
Your Gateway for Information about Biomedical Imaging and Bioengineering at the National Institutes of Health

About NIBIB | For Investigators | For Students | News & Events
BECON | NIBIB | General Information

A Guide to the NIH | Join the NIBIB Listserv

The National Institute for Biomedical Imaging and Bioengineering (NIBIB) is the newest of the research institutes at the National Institutes of Health (NIH). The NIBIB is authorized by law H.R. 1795 (P.L. 106-580) which was signed by President William Clinton on December 29, 2000.

The mission of the NIBIB is to "improve health by promoting fundamental discoveries, design and development, and translation and assessment of technological capabilities. The Institute coordinates with biomedical imaging and bioengineering programs of other agencies and NIH institutes to support imaging and engineering research with potential medical applications and facilitates the transfer of such technologies to medical applications."

What's New?

- Registration Now Open for BECON 2003 Symposium
- Chairs Named for BECON 2003 Symposium on Team Science
- First NIBIB Advisory Council Meeting Conducted
- Dr. Robert Nerem to Serve as Bioengineering

NIH BIOENGINEERING CONSORTIUM (BECON)

BECON Symposia: Guiding the Science, Guiding the Programs

Bioengineering: Building the Future of Biology and Medicine	February 27-28, 1998
Biomedical Imaging: Visualizing the Future of Biology and Medicine	June 25-26, 1999
Nanoscience and Nanotechnology: Shaping Biomedical Research	June 25-26, 2000
Reparative Medicine: Growing Tissues and Organs	June 25-26, 2001
Sensors in Biological Research and Medicine	June 24-25, 2002
Catalyzing Team Science	June 23-24, 2003

NIH BIOENGINEERING CONSORTIUM (BECON)

http://www.becon.nih.gov/symposium2003.htm

BECON 2003 SYMPOSIUM
CATALYZING TEAM SCIENCE
June 23-24, 2003

Natcher Conference Center, National Institutes of Health
Bethesda, Maryland

PRELIMINARY AGENDA

Extramural Co-Chairs: H. Keith H. Brodie, MD (Duke) & Janie Fouke, PhD (Michigan State)
BECON Planning Committee Chair: Daniel C. Sullivan, MD (NIH/NCI)

GOAL: To examine the forces encouraging and discouraging team approaches in biomedical research, and to explore new ways in which NIH, academia and others can work together to stimulate and reward team efforts.

NIH BIOENGINEERING CONSORTIUM (BECON)

http://
www.becon.nih.gov/
becon_symposia.htm

Nanoscience and Nanotechnology:

Shaping Biomedical Research

June 2000

Symposium Report

National Institutes of Health
Bioengineering Consortium

BIOENGINEERING RESEARCH SUPPORT AT NIH

Bioengineering Research Grants

- For basic and applied multi-disciplinary research that addresses important biological or medical research problems.
- Hypothesis-driven, discovery-driven, developmental, or design-directed research.
- Multi-disciplinary research performed in a single laboratory or by a small number of investigators that applies an integrative, systems approach to develop knowledge and/or methods to prevent, detect, diagnose, or treat disease or to understand health and behavior.
- Research Project (R01) mechanism
- Applications Receipt: February 1, June 1, and October 1
- http://grants.nih.gov/grants/guide/pa-files/PA-02-011.html

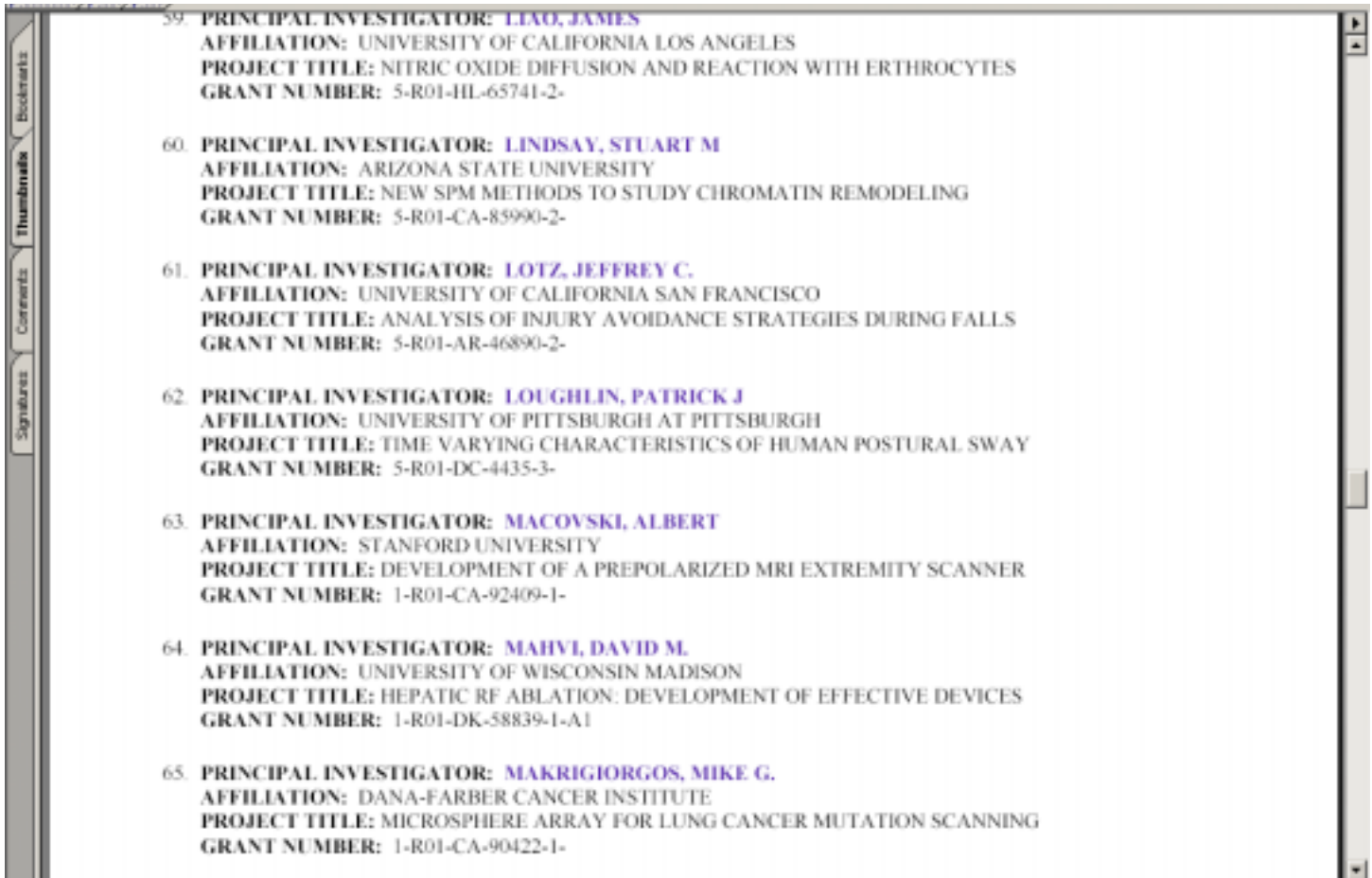
NIH BIOENGINEERING CONSORTIUM (BECON)

BIOENGINEERING RESEARCH AREAS

- Behavioral science
- Biomechanics
- Bioprocessing
- Bioelectrics, ion channels, and organ function
- Clinical medicine, therapeutics and drug delivery
- Combinatorial approaches to chemistry, materials, genes, and therapeutics
- Functional genomics including microarray technology, integrated systems, and analytical tools
- Imaging, molecular imaging, and image-guided methods
- Nanotechnology and microtechnology
- Informatics, databases, and computational methods
- Computational modeling and simulation
- Medical implants, biomembranes, sensors and devices
- Optics
- Complex biological systems
- Organ culture systems and organogenesis
- Rehabilitation and prostheses
- Cell and tissue engineering and biomaterials
- Tissue regeneration
- Integrative physiology
- Drug bioavailability
- Telemedicine
- Computer-assisted diagnosis and procedures

BIOENGINEERING RESEARCH SUPPORT AT NIH

Bioengineering Research Grants
>140 funded since FY 99
http://www.becon.nih.gov/Funded/BRG02.pdf



59. **PRINCIPAL INVESTIGATOR:** LIAO, JAMES
AFFILIATION: UNIVERSITY OF CALIFORNIA LOS ANGELES
PROJECT TITLE: NITRIC OXIDE DIFFUSION AND REACTION WITH ERTHROCYTES
GRANT NUMBER: 5-R01-HL-65741-2-

60. **PRINCIPAL INVESTIGATOR:** LINDSAY, STUART M
AFFILIATION: ARIZONA STATE UNIVERSITY
PROJECT TITLE: NEW SPM METHODS TO STUDY CHROMATIN REMODELING
GRANT NUMBER: 5-R01-CA-85990-2-

61. **PRINCIPAL INVESTIGATOR:** LOTZ, JEFFREY C.
AFFILIATION: UNIVERSITY OF CALIFORNIA SAN FRANCISCO
PROJECT TITLE: ANALYSIS OF INJURY AVOIDANCE STRATEGIES DURING FALLS
GRANT NUMBER: 5-R01-AR-46890-2-

62. **PRINCIPAL INVESTIGATOR:** LOUGHLIN, PATRICK J
AFFILIATION: UNIVERSITY OF PITTSBURGH AT PITTSBURGH
PROJECT TITLE: TIME VARYING CHARACTERISTICS OF HUMAN POSTURAL SWAY
GRANT NUMBER: 5-R01-DC-4435-3-

63. **PRINCIPAL INVESTIGATOR:** MACOVSKI, ALBERT
AFFILIATION: STANFORD UNIVERSITY
PROJECT TITLE: DEVELOPMENT OF A PREPOLARIZED MRI EXTREMITY SCANNER
GRANT NUMBER: 1-R01-CA-92409-1-

64. **PRINCIPAL INVESTIGATOR:** MAHVI, DAVID M.
AFFILIATION: UNIVERSITY OF WISCONSIN MADISON
PROJECT TITLE: HEPATIC RF ABLATION: DEVELOPMENT OF EFFECTIVE DEVICES
GRANT NUMBER: 1-R01-DK-58839-1-A1

65. **PRINCIPAL INVESTIGATOR:** MAKRIGIORGOS, MIKE G.
AFFILIATION: DANA-FARBER CANCER INSTITUTE
PROJECT TITLE: MICROSPHERE ARRAY FOR LUNG CANCER MUTATION SCANNING
GRANT NUMBER: 1-R01-CA-90422-1-

BIOENGINEERING RESEARCH SUPPORT AT NIH

Bioengineering Research Partnerships

- For basic and applied research by a multi-disciplinary team applying an integrative, systems approach to develop knowledge and/or methods to prevent, detect, diagnose, or treat disease or to understand health and behavior.
- Partnership must include bioengineering expertise and basic and/or clinical expertise.
- Maximum request = $2M per year for five years
- Need approval > 6 wks before submission if request > $500,000 direct cost
- Research Project (R01) mechanism
- Application receipt: January 23, 2003, and August 22, 2003
- http://grants.nih.gov/grants/guide/pa-files/PAR-03-032.html

BIOENGINEERING RESEARCH SUPPORT AT NIH

Bioengineering Research Partnerships

FY 99	13 awards
FY 00	21 awards
FY 01	26 awards
FY 02	45 awards

http://www.becon.nih.gov/Funded/BRP02.pdf

30. **Principal Investigator:** Maudsley, Andrew **Affiliation:** UNIVERSITY OF MIAMI
Project Title: PARTNERSHIP FOR MR SPECTROSCOPIC IMAGING DATA PROCESSING
Grant Number: 1-R01-EB-822-1- **Funding Organization:** NIBIB
Abstract:

MR Spectroscopic Imaging (MRSI) enables non-invasive measurement of a number of tissue metabolite distributions and offers considerable potential as a diagnostic imaging technique. Widespread adoption of MRSI has been limited by complex requirements for data processing and analysis, which optimally require close integration of known spectral and spatial information, including MRI-derived tissue segmentation, morphological analysis, metabolite NMR characteristics, and detailed knowledge of normal tissue metabolite distributions. This Biomedical Research Partnership will address this limitation and increase the effectiveness of MRSI by developing an integrated set of data processing tools that emphasizes considerable automation and suitability for routine diagnostic imaging studies. This effort will combine multiple areas of expertise in MRSI and MRI data processing under 5 projects located at 4 institutions. Software tools will be developed for automated MRSI processing, tissue segmentation, brain region mapping, statistical analysis, and clinical presentation. The resultant technical developments will then be shared among several partners at collaborating medical research centers in the U.S.A., Europe, and Japan, where the package will be evaluated for diagnostic neuroimaging applications, with an emphasis on 1H MRSI of cancer, epilepsy and neurodegenerative disease. Results from metabolite imaging studies will be converted to standardized intensity units and transformed into normalized spatial coordinates, enabling the data to be pooled to form a database of MR-measured human metabolite values as a function of acquisition, spatial, and subject parameters. This information will then be used to enhance statistical analysis of individual MRSI studies. The developed methods will facilitate increased use of MRSI for diagnostic imaging, encourage the development of standardized MRSI acquisition, processing, and analysis methods, and map metabolite distributions in human brain.

31. **Principal Investigator:** Mcknight, Timothy **Affiliation:** UT-BATTELLE, LLC-OAK RIDGE NATIONAL LAB
Project Title: Nano Arrays for Real-Time Probing Within Living Cells
Grant Number: 1-R01-EB-433-1-A1 **Funding Organization:** NIBIB
Abstract:

This project will exploit the recent development of rigid, vertically aligned, carbon nanofiber arrays to provide nanoscale probes for mapping intra and extracellular molecular events in and around living cells in real time with extremely high spatial resolution (< 50 nm probing areas). Devices will be fabricated and characterized to determine the performance of nanoscale arrays as independently addressable electrochemical molecular probes. Characterizations will be performed using a set of standard analytes that have been routinely used for characterization of carbon-based electrode systems (year 1). Probe response to hydrogen peroxide and superoxide anion will then be characterized (year 1 into year 2). Strategies and methods will then be

BIOENGINEERING RESEARCH SUPPORT AT NIH

Exploratory/Developmental Bioengineering Research Grants (EBRG)

NEW

- To support innovative, high risk/high impact bioengineering research in new areas that are lacking preliminary testing or development.
- For basic and applied multi-disciplinary research that addresses important biological or medical research problems.
- Hypothesis-driven, discovery-driven, developmental, or design-directed research.
- R21 mechanism.
- Up to $275,000 direct costs over 2 years.
- Applications Receipt: February 1, June 1, and October 1
- http://grants.nih.gov/grants/guide/pa-files/PA-03-058.html

Current NIH Biomedical Engineering Research Funding Opportunities

- Noninvasive Measurement of Iron by Magnetic Resonance Imaging - RFA-DK-03-007 - Application Receipt date: February 19, 2003
- Noninvasive Measurement of Iron by Magnetic Resonance Imaging (SBIR/STTR) - RFA-DK-03-009 - Application Receipt date: February 19, 2003
- Muscular Dystrophy Cooperative Research Centers - RFA-AR-03-001 - Application Receipt date: February 24, 2003
- Clinical Research in Peripheral Arterial Disease - RFA-HL-03-003 - Application Receipt date: February 26, 2003
- Bench to Bedside Research on Type 1 Diabetes and its Complications - RFA-DK-03-001 - Application Receipt date: February 26, 2003
- Collaborative Initiative on Fetal Alcohol Spectrum Disorders RFA-AA-03-002 - Application Receipt date: March 11, 2003
- Stem Cell Potential of the Mammalian Olfactory Epithelium - RFA-DC-03-002 - Application Receipt date: March 11, 2003
- Telehealth Technologies Development - RFA-EB-03-005 - Application Receipt date: March 13, 2003
- Low-Cost Medical Imaging Devices - RFA-EB-03-006 - Application Receipt date: March 14, 2003
- Research Opportunities in Tissue Engineering - RFA-EB-03-010 - Application Receipt date: March 14, 2003
- The Life Cycle of the Adipocyte - RFA-DK-03-002 - Application Receipt date: March 14, 2003
- Improvements in Imaging Methods and Technologies - RFA-EB-03-007 - Application Receipt date: March 24, 2003
- Development of Novel Drug and Gene Delivery Systems and Devices - RFA-EB-03-011 - Application Receipt date: March 25, 2003
- Image-Guided Interventions - RFA-EB-03-008 - Application Receipt date: March 25, 2003

BIOENGINEERING RESEARCH SUPPORT AT NIH

Mentored Quantitative Research Career Development (K25)

Revised

- For research-oriented physical/mathematical scientists and engineers to engage in supervised study & research leading to increased competence to perform biomedical, behavioral, bioengineering or bioimaging research.
- PI's on NIH grants are not eligible
- Up to five years of support, NIH/IC limit on salary, $40,000 supplies/personnel/travel/tuition
- Requires commitment of 75% of effort
- Application Receipt: February 1, June 1, and October 1
- http://grants.nih.gov//grants/guide/pa-files/PA-02-127.html

NIH Bioengineering Training Opportunities

by Career Level

Undergraduate

Biomedical Engineering Summer Internship Program

Graduate/Pre-doctoral

National Research Service Award (NRSA) Biotechnology - Pre-doctoral Institutional Awards

NRSA for Individual Pre-doctoral Fellows (F31) – PA-00-125

NRSA Institutional Training Grants (T32) – PA-00-103

Individual Pre-doctoral National Training Research Service Awards for M.D./PhD. Fellowships (F30) – PA-99-089

Institutional Training Grants In Genomic Analysis and Interpretation (T32) – PA-99-028

System and Integrative Biology – NIGMS (T32) – Pre-doctoral Institutional Awards

Medical Scientist (M.D.-Ph. D.) Training Program (MSTP) - NIGMS (T32) - Institutional Award for the support of trainees participating in a dual degree program

Post-doctoral

Biomedical Engineering (NRSA)- Post-doctoral Individual Awards

Imaging Sciences Training Program – MD/PhD Individual Awards

NRSA Institutional Training Grants (T32) – PA-00-103

Individual Postdoctoral and Senior Fellowships in Genomics and Related ELSI Topics (F32, F33) – PA-99-122

Institutional Training Grants In Genomic Analysis and Interpretation (T32) – PA-99-028

The NEI Scholars Program (K22) - PAR-98-107

Career Development

Cancer Education and Career Development Program – (R25T) – PAR-00-046

Senior Scientist Award (K05) – PA-00-021

Mentored Clinical Scientist Development Award (K08) – PA-00-003

Mentored Quantitative Research Career Development Award (K25) - PA-99-087

NANOTECHNOLOGY RESEARCH AT NIH

NIH goals for NNI

are exemplified in the

Grand Challenge for Healthcare

NIH
NANOTECHNOLOGY FOCUS AREAS (1)

Detecting Disease *Before* Health Has Deteriorated Substantially

- Imaging (optical, MRI, ultrasound)
  - Better electronics and computational capacity
    - NIH leverages these advances supported by other agencies to improve imaging hardware and software
  - "Smart" contrast agents
    - Agent becomes visible only in the presence of a particular physiological indicator such as calcium ions, pressure, or a particular protein

NIH
NANOTECHNOLOGY FOCUS AREAS (2)

Detecting Disease *Before* Health Has Deteriorated Substantially (cont.)

- Sensors
  - Laboratory assay of body fluids
    - Bench-top systems for rapid tests of multiple indicators of disease and infection
  - Susceptibility testing - help healthy people to avoid risks
    - Gene-based and physiological tests to discover predispositions and pre-emerging disease
  - Implants for real-time monitoring
    - Detect disease or infection at the stage of few cells
    - Engineered surfaces to prevent fouling
    - Multi-component “closed loop” systems to initiate preventive action when a fault is reported

NIH
NANOTECHNOLOGY FOCUS AREAS (3)

Implants to Replace Worn or Damaged Body Parts

- Novel “bioactive coatings” to control interactions of synthetic and inorganic materials with bone, blood, and other tissues
- Parts that become integrated into the body and last a long time

NIH
NANOTECHNOLOGY FOCUS AREAS (4)

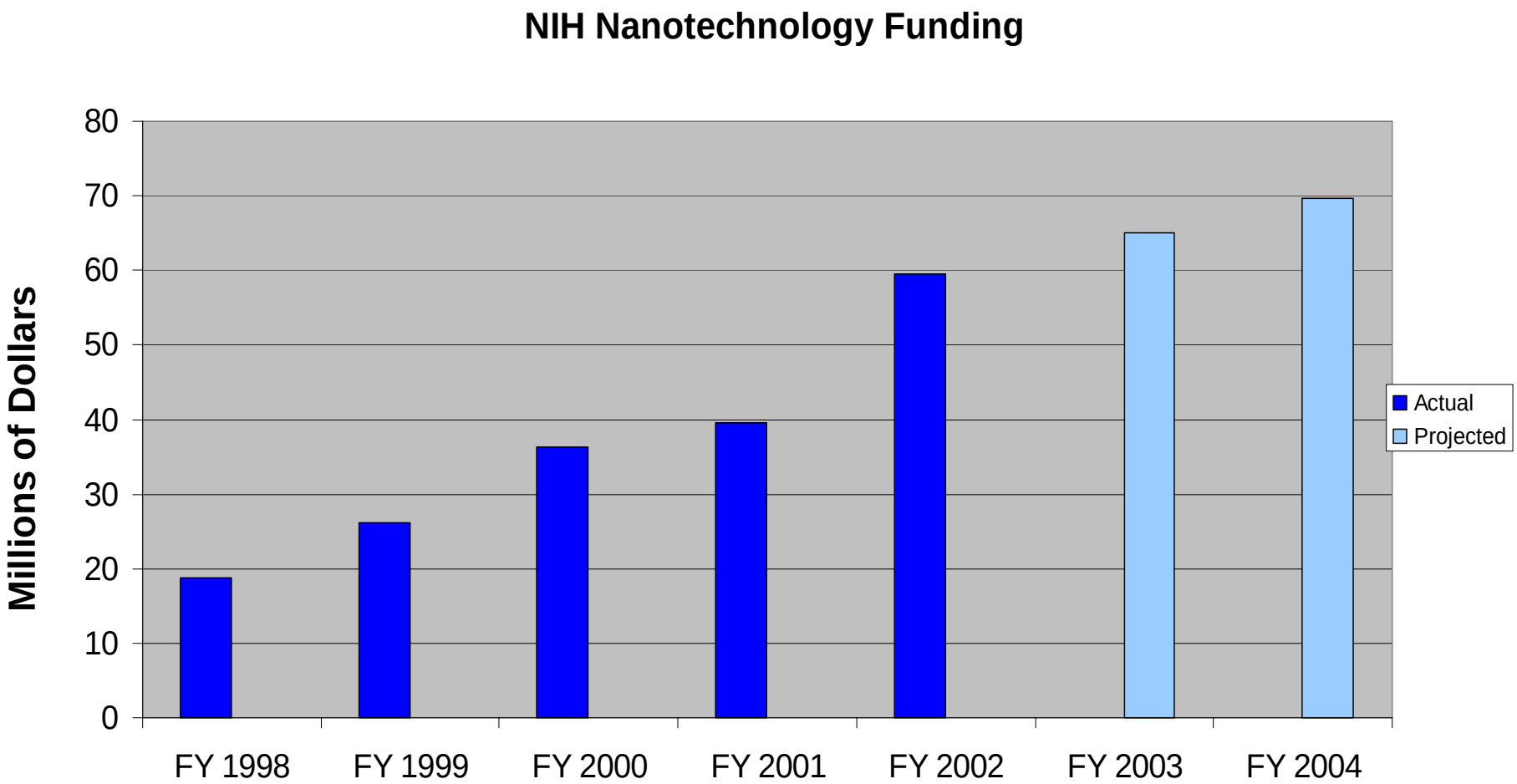
Delivery Of Therapeutics

- Compounds that are insoluble or toxic to some body systems can be delivered directly to their site of action resulting in lower total body concentration and greater effectiveness. Nanotechnology offers ways to deliver materials to locations that might be otherwise inaccessible.

- Gene therapy delivery - enhanced targeting to the tissue or cells of interest

RESEARCH TOOLS AND HUMAN HEALTH

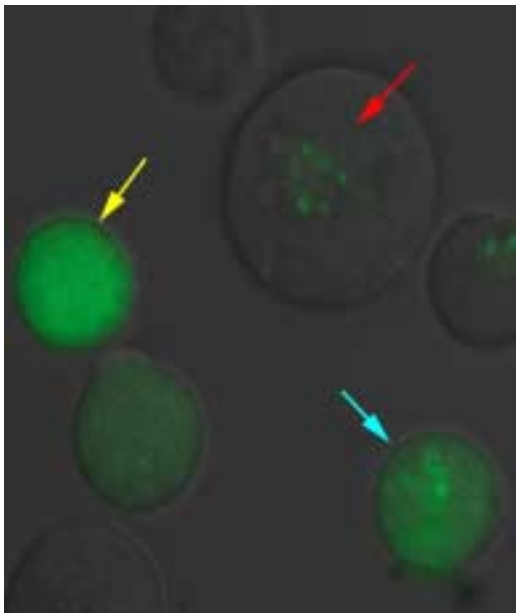
- Devices and processes developed to meet specific health challenges will have counterparts that will be used in health research laboratories to better understand the biological basis of health and disease.
- Sensors needed to monitor soldiers in the field and astronauts in space, and devices to treat them, are related to those needed closer to home. NIH components:
  - have co-funded grants and sponsored workshops with other agencies, on sensor technologies that include nanotechnology.
  - are exchanging ideas with other agencies on tissue engineering initiatives that will incorporate nanotechnology research.
- These advances and applications will require multi-disciplinary and multi-agency efforts.


NIH Nanotechnology Funding
Millions of Dollars
80
70
60
50
40
30
20
10
0
FY 1998
FY 1999
FY 2000
FY 2001
FY 2002
FY 2003
FY 2004
Actual
Projected

NANOTECHNOLOGY RESEARCH AT NIH

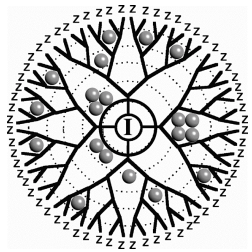
The majority of nanoscience and nanotechnology research at the NIH is supported through programs other than those initiated by BECON.

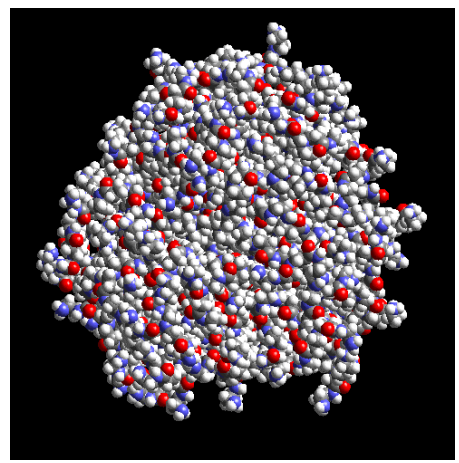
The following are examples of bionanotechnology research (most of which are) currently supported by Institutes and Centers of the NIH.



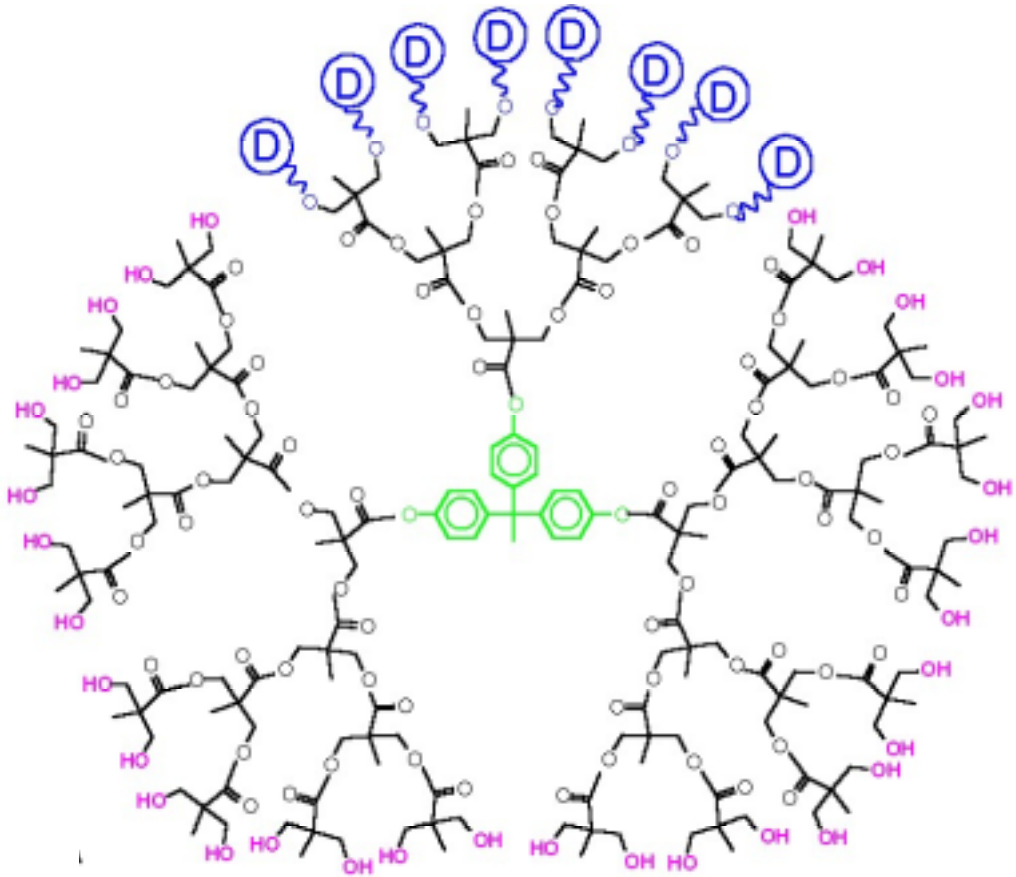
UNIVERSITY OF MICHIGAN

James Baker, M.D.





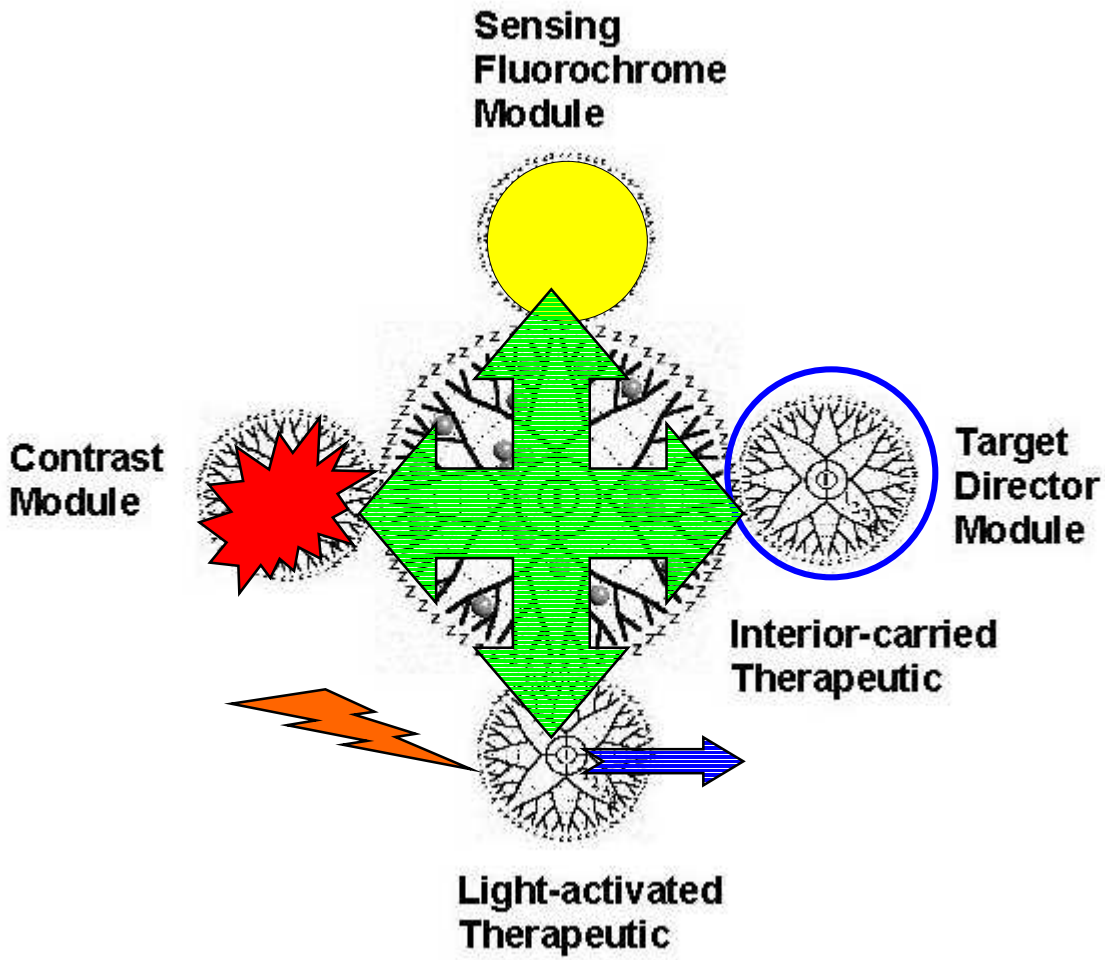
Multifunctional nano-devices based on dendritic polymer components will be developed that target neoplastic cells and sense the earliest signatures of cancer. The dendritic nano-devices will be designed to support the specific release of a therapeutic agent within a tumor, and analyze the effect of the therapeutic identifying evidence of residual disease.

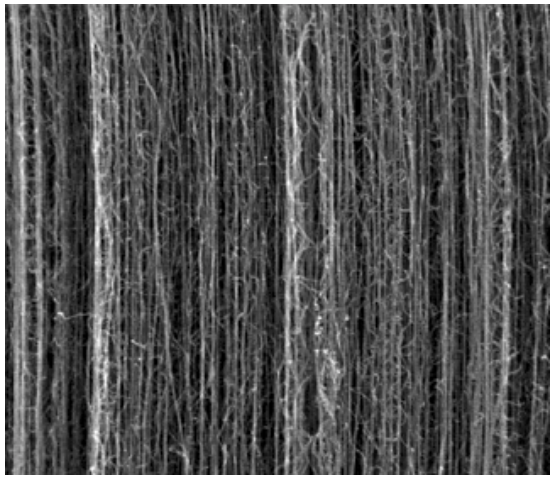


Dendrimer structure, from Jean Frechet, U.C. Berkeley

UNIVERSITY OF MICHIGAN

James Baker, M.D.





NASA AMES RESEARCH CENTER

Meyya Meyyappan, Ph.D.

NASA Ames Research Center

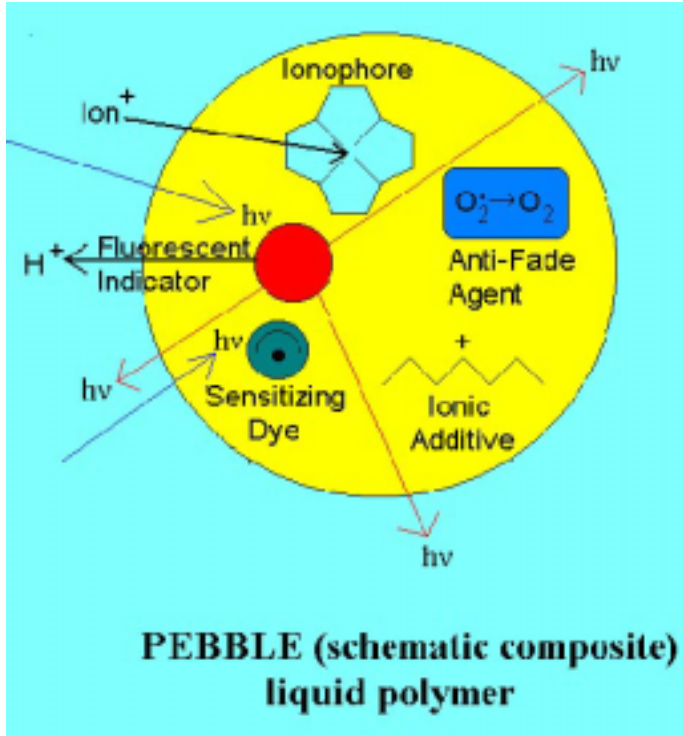
Carbon nanotubes (CNT) exhibit unique electronic and extraordinary mechanical properties. Ames has grown CNT, only 1 nm in diameter in the form of films and aligned bundles, and is currently making an effort to grow vertical tubes of controlled length for sensor development. The tip of the nanotubes will be functionalized with appropriate probe molecules for diagnostics. A prototype catheter will be developed which would permit detection of specific oligonucleotide sequences that serve as molecular signatures of cancer cells.

NATIONAL CANCER INSTITUTE

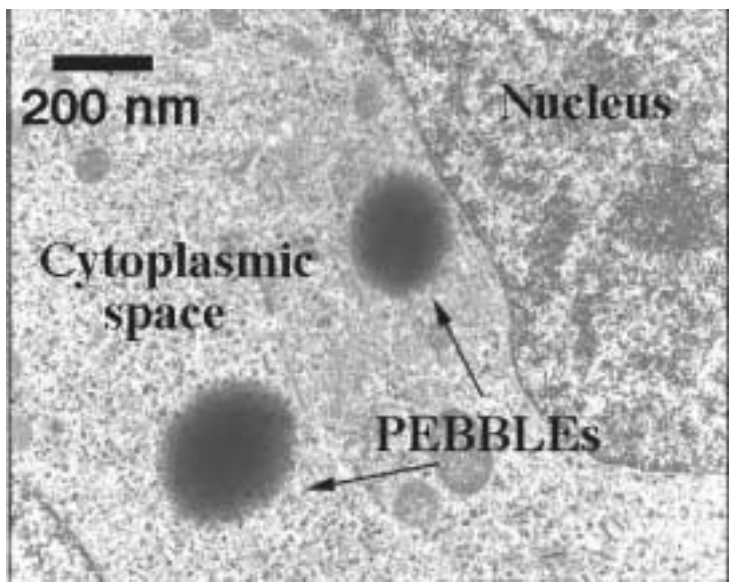
UNIVERSITY OF MICHIGAN

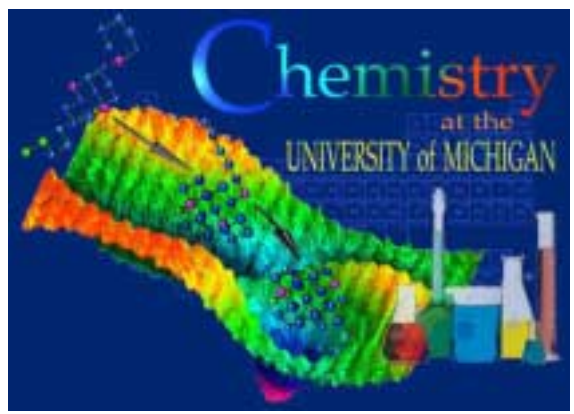
Raoul Kopelman, Ph.D.

The objective is to produce optical nanosensors for direct, real-time chemical imaging of cellular membranes and intracellular processes. These sensors will monitor pH, calcium, magnesium, sodium, potassium, chloride, oxygen, nitrite, nitric oxide, carbon dioxide and glucose.



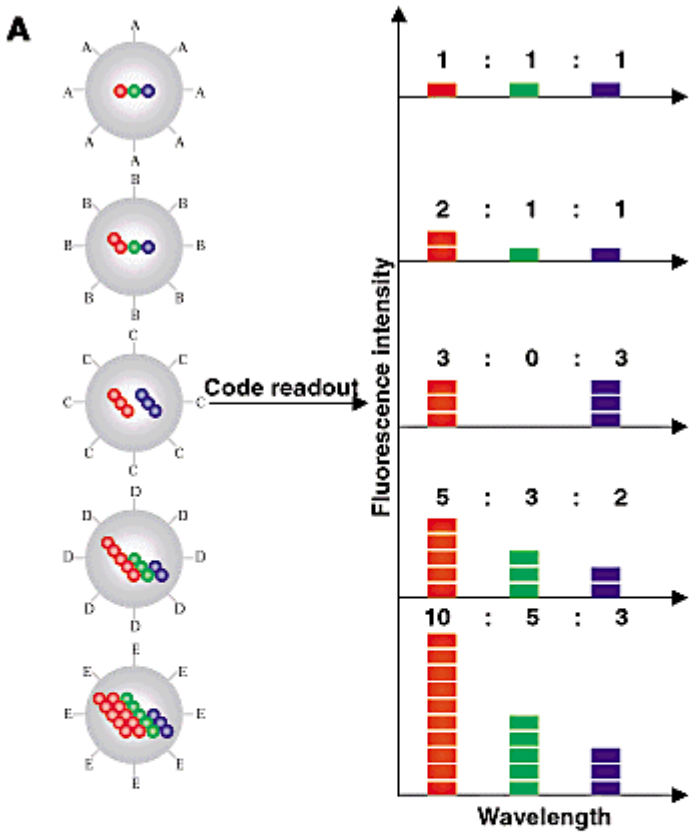
PEBBLE (schematic composite) liquid polymer

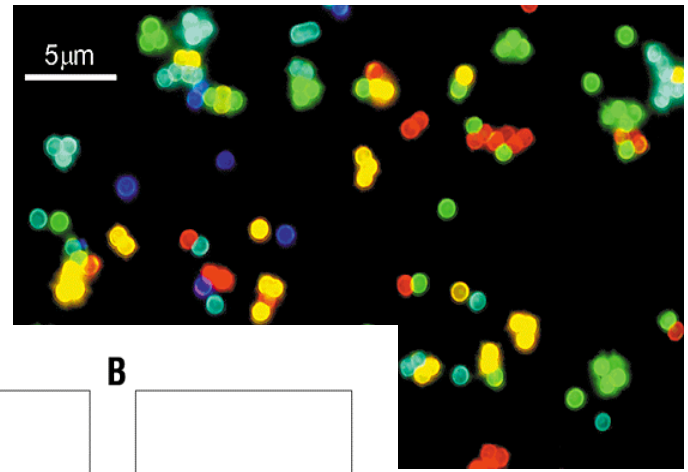


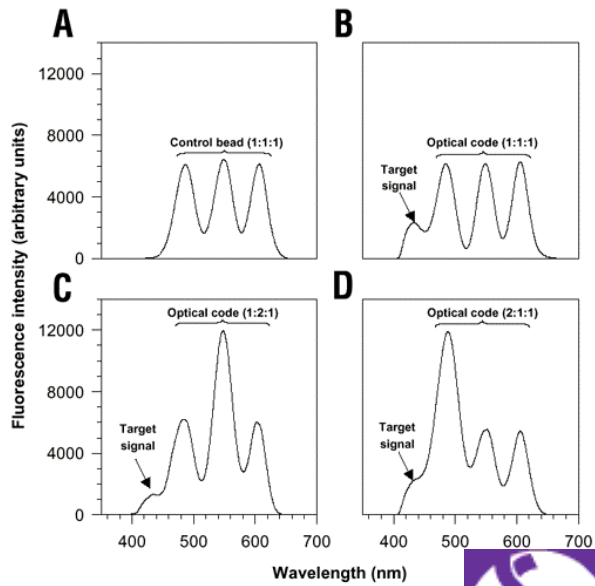


NIGMS

INDIANA UNIVERSITY
Department of Chemistry
Shuming Nie, Ph.D.

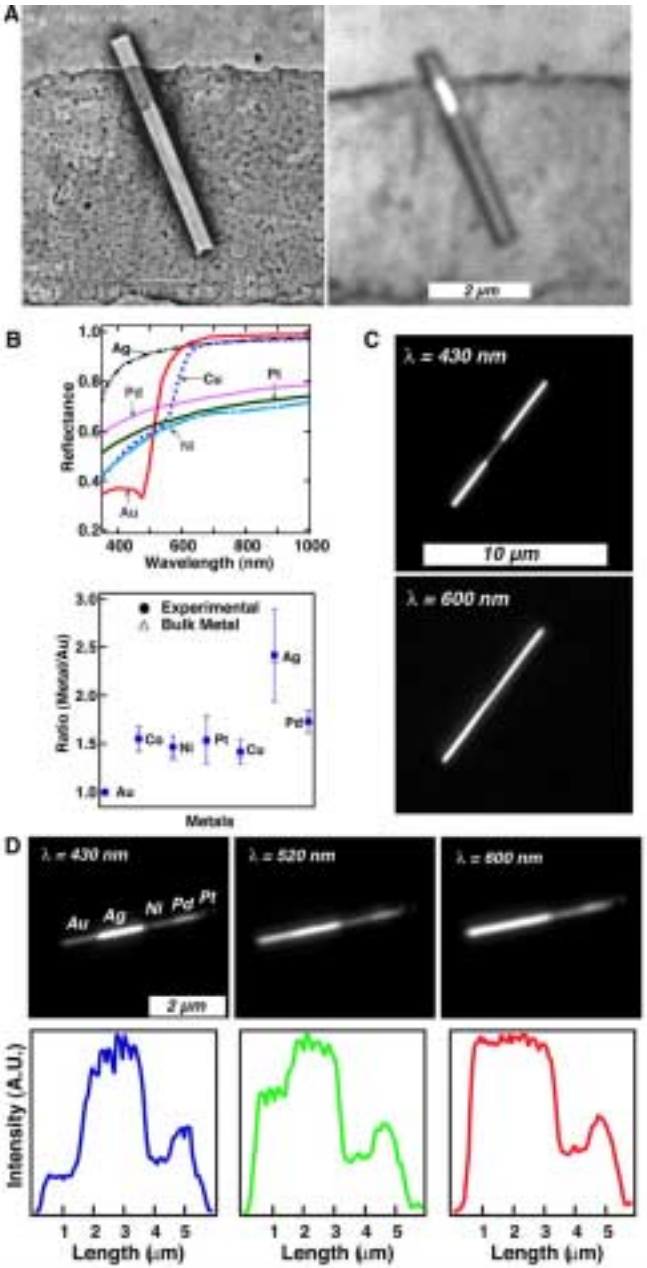






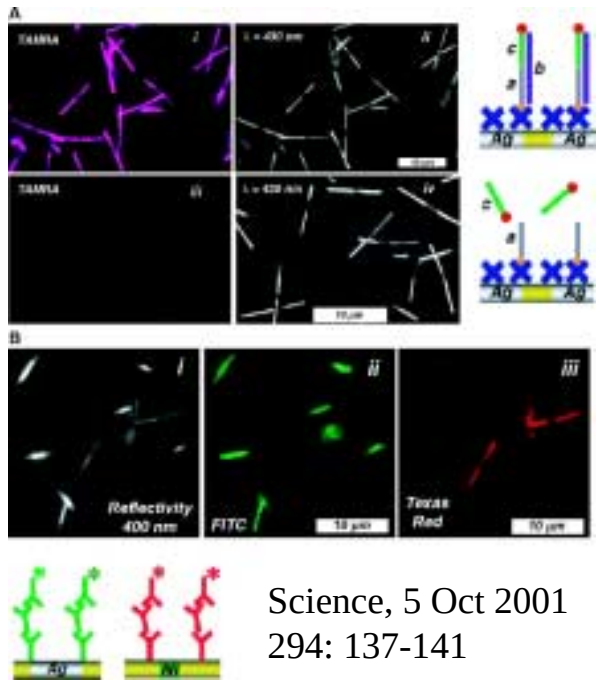
Figures from Nature Biotechnology July 2001

NIGMS



PENNSYLVANIA STATE UNIV.
Christine D. Keating, Ph.D.

SURROMED, INC.
Michael J. Natan, Ph.D.



Science, 5 Oct 2001
294: 137-141

Submicron metallic barcodes for high throughput DNA and protein assays.

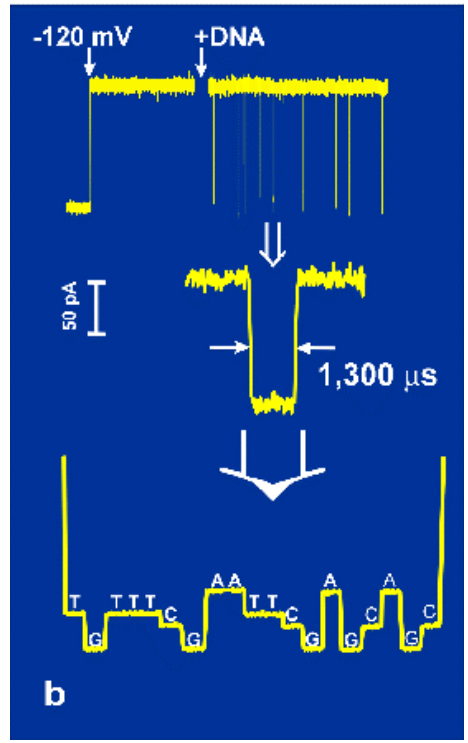
NATIONAL HUMAN GENOME RESEARCH INSTITUTE

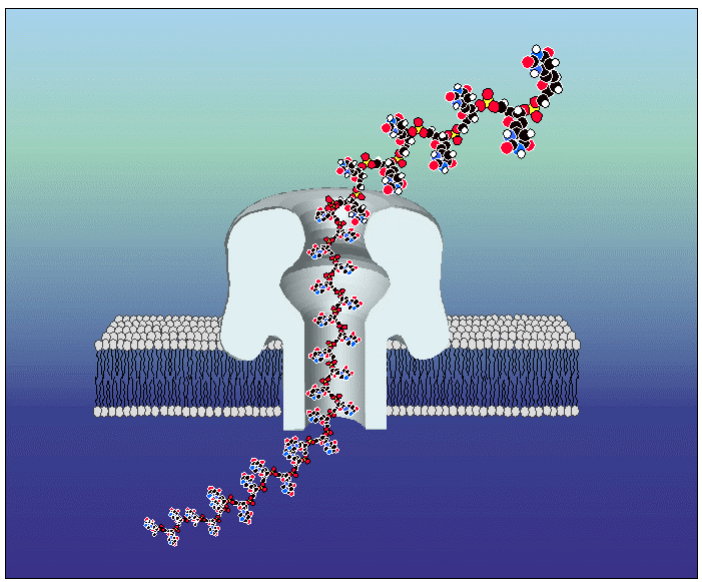
UNIV. OF CALIFORNIA SANTA CRUZ

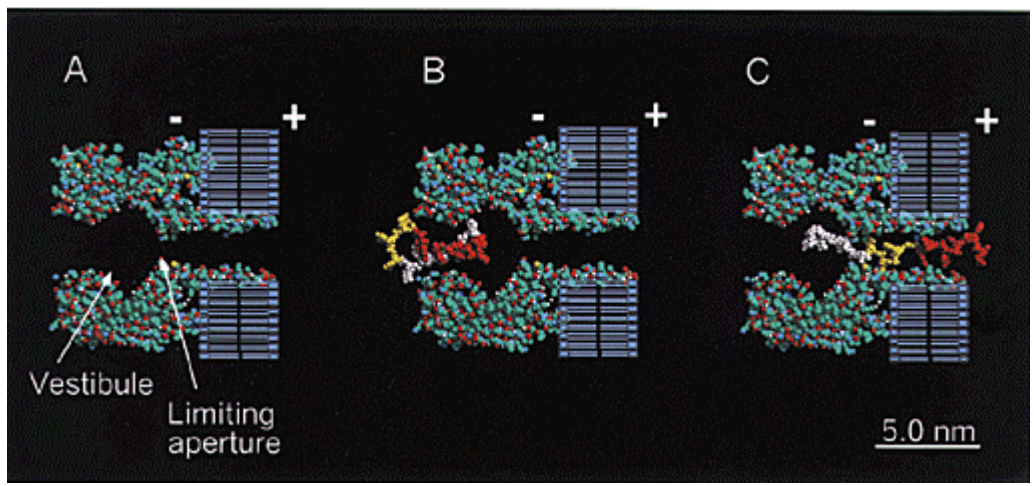
Department of Chemistry & Biochemistry
David W. Deamer, Ph.D.

UC SANTA CRUZ

Single-stranded nucleic acid molecules passing through a nanometer-sized pore modulate the ionic conductance across the membrane. This observation may one day lead to a device for single molecule DNA sequencing.







PRINCETON UNIVERSITY

Edward C. Cox, Ph.D.

Robert Austin, Ph.D.

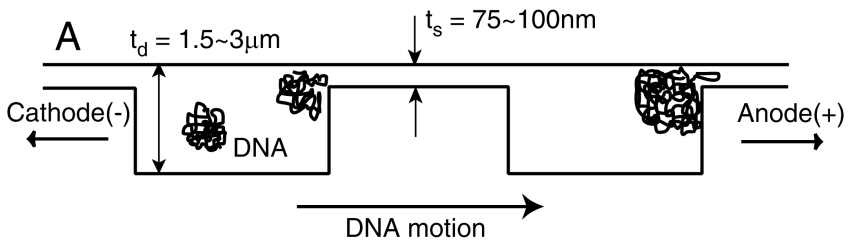
Princeton University

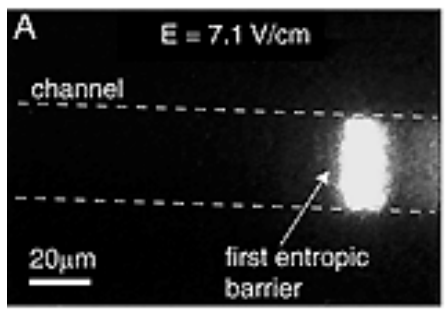
CORNELL UNIVERSITY

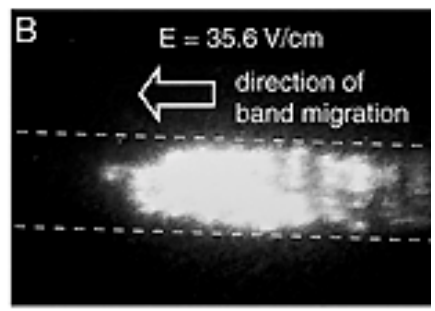
Harold G. Craighead, Ph.D.

CORNELL UNIVERSITY

Structures nanofabricated in silicon may replace polymers in devices for DNA analysis. In this experiment, DNA molecules are trapped in deep entropic traps until a portion of the molecule stretches so that it can enter the shallow space, and then the rest of the molecule follows. DNA separations that would ordinarily take 12-24 hours took only 15-30 minutes. Similar systems could be used to analyze other kinds of molecules.



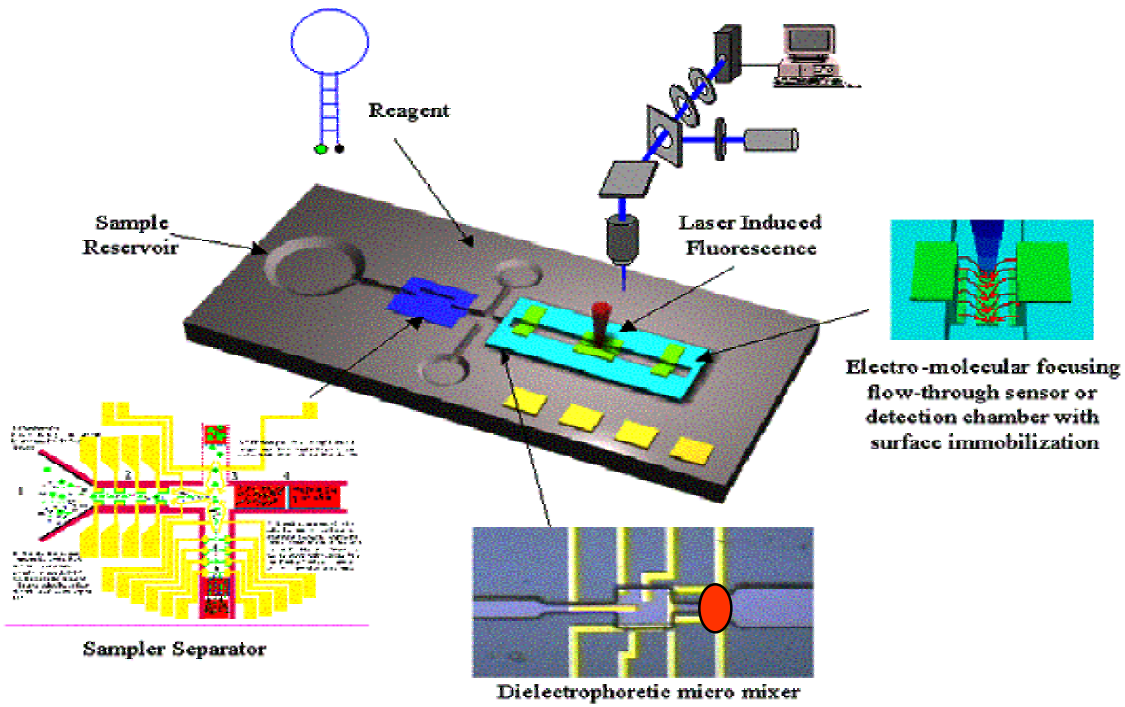




Laboratory assay of body fluids

1. Bench-top systems for rapid tests of multiple indicators of disease and infection.

2. Monitor people in health and diseases.



The detection chip includes: i) a chamber inlet where saliva is introduced ii) phase shifted electric fields that enable traveling wave dielectrophoresis which focuses the stream of cells in the microfluidic flow channel for subsequent separation; iii) flow with specific amplitudes and frequencies of the AC electric field for the separation of cell from proteins and; iv) the detection chamber that includes the different ligand for simultaneous optical detection of multiple analytes.

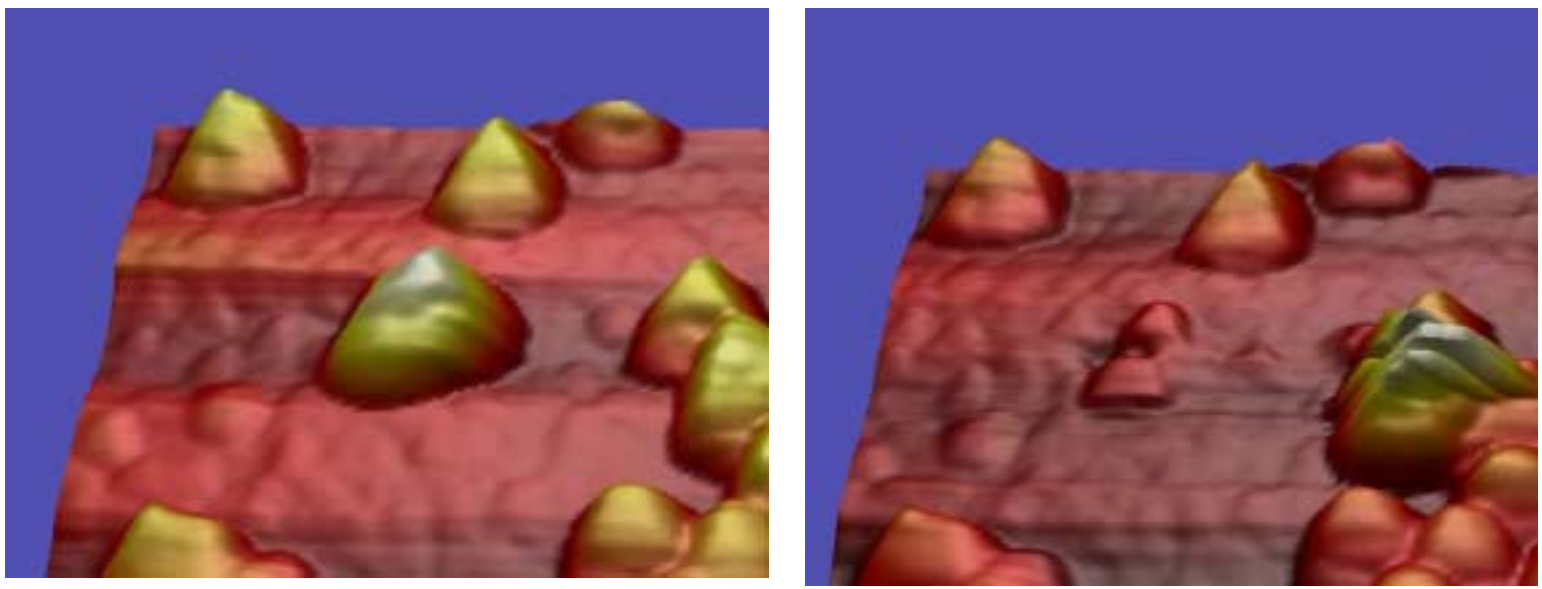
Provided by Drs. David Wong and Chih-Ming Ho. UCLA

UNIVERSITY OF NORTH CAROLINA AT CHAPEL HILL

Department of Computer Science

Frederick P. Brooks, Jr., Ph.D.

The nanoManipulator, a national user resource, is a modified Scanning Force Microscope. The sample can be imaged and manipulated by interfacing a hand-held force stylus with the scanning tip of the microscope. http://www.cs.unc.edu/Research/nano/doc/biovisit.html



Manipulation of an adenovirus particle (~ 90 nm).

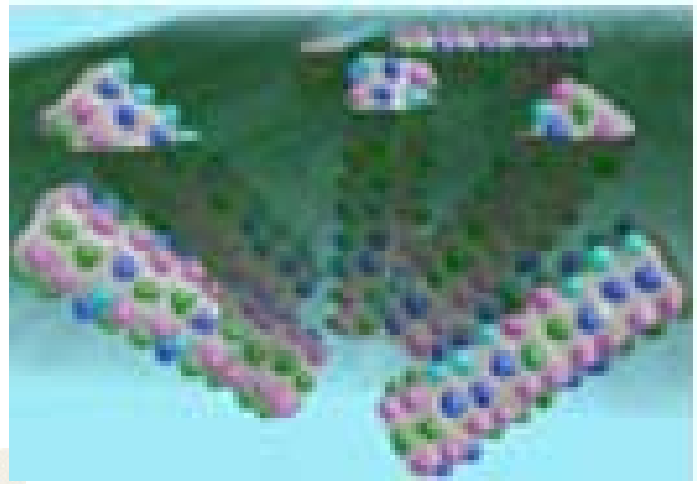
National Center For Research Resources

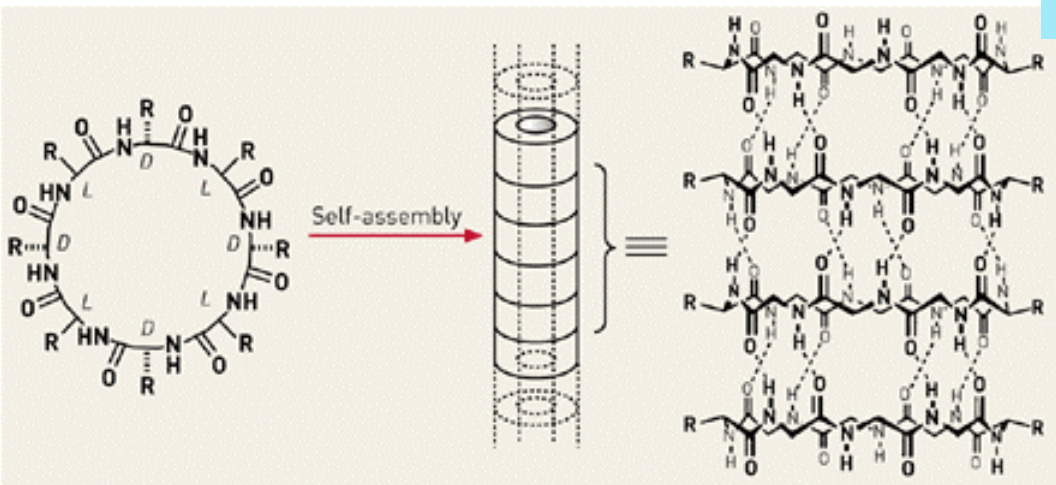
SCRIPPS RESEARCH INSTITUTE

M. Reza Ghadiri, Ph.D.

THE SCRIPPS RESEARCH INSTITUTE

A new class of antibacterial peptides is being developed. Nanotubes are formed by self-assembly of cyclic peptides composed of alternating D- and L-amino acids. With appropriate design, the nanotubes insert themselves into bacterial, but not mammalian, cell membranes. Pores are created, resulting in bacterial cell death.

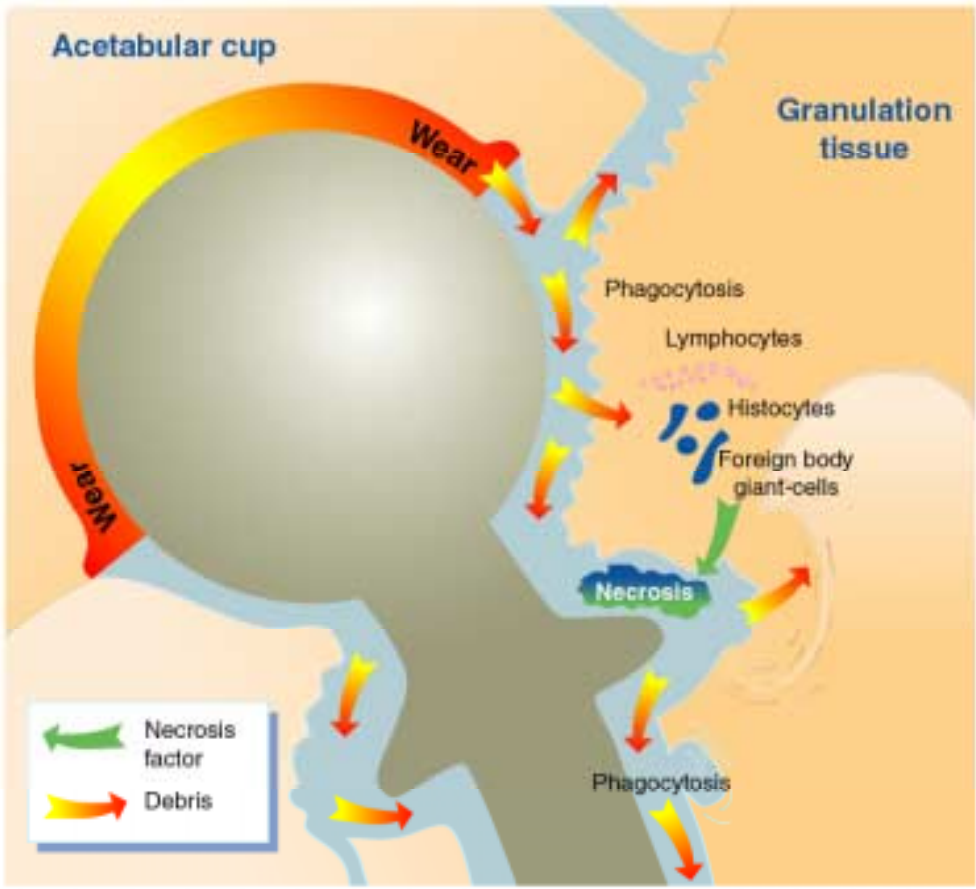




Figures are from C&E News, August 6, 2001

NIGMS

Total Hip Replacement - Osteolysis



We take about one million steps a year.

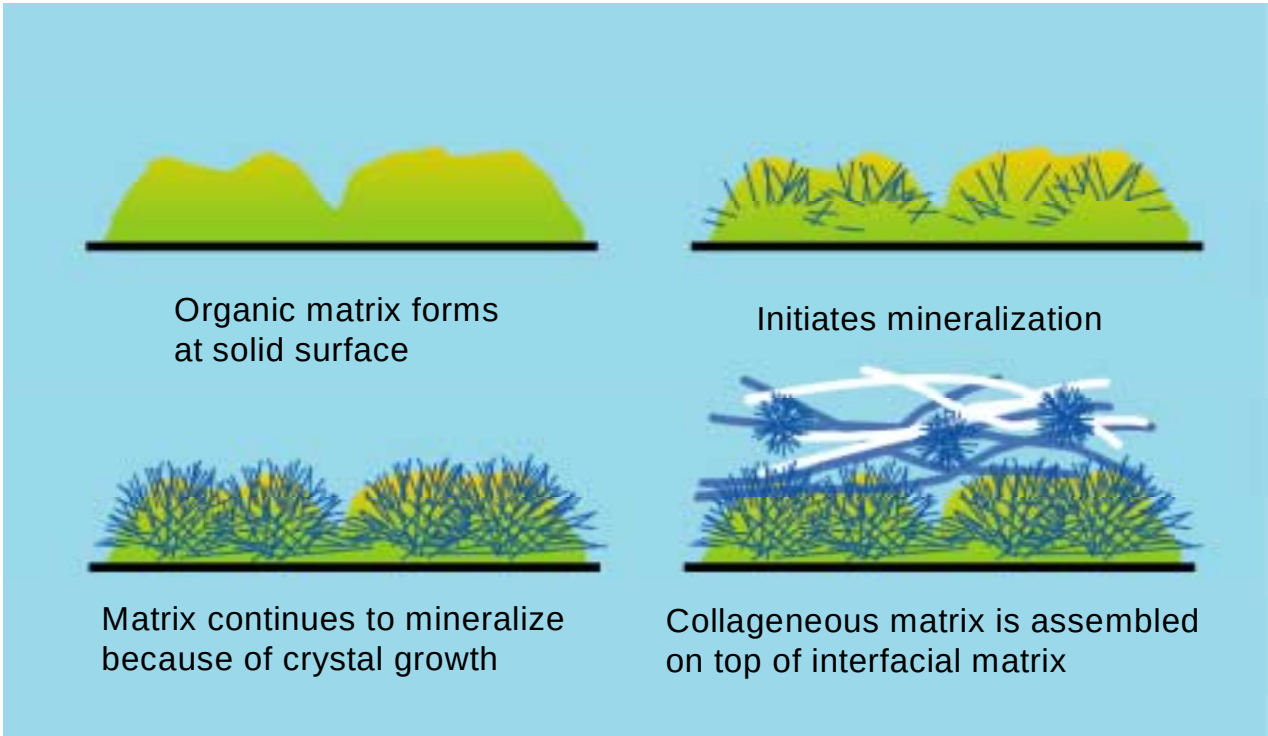
As years pass, strong shock waves caused by walking, running & climbing erode cushioning between ball & socket at top of leg.

Soon, bone grinding on bone causes osteoarthritis, a condition that brings crippling pain and slows everything we do.

What's the answer? For more than 250,000 Americans a year: hip replacement surgery.

Provided by Dr. Tony Tomsia, Lawrence Berkeley National Laboratory (LBNL)

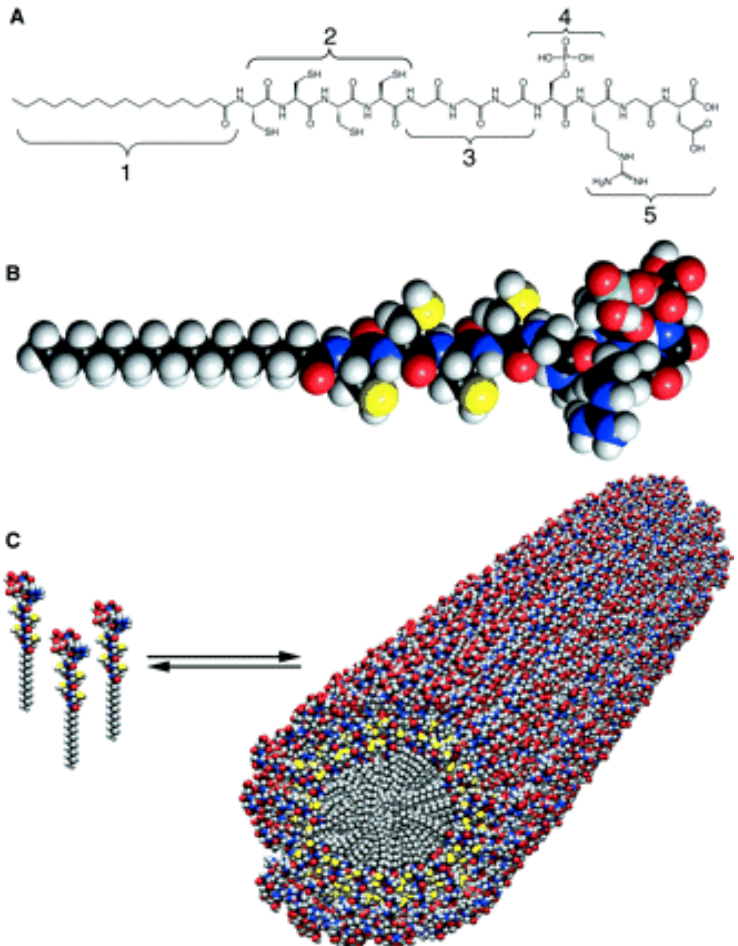
Bone Formation on Solid Surfaces

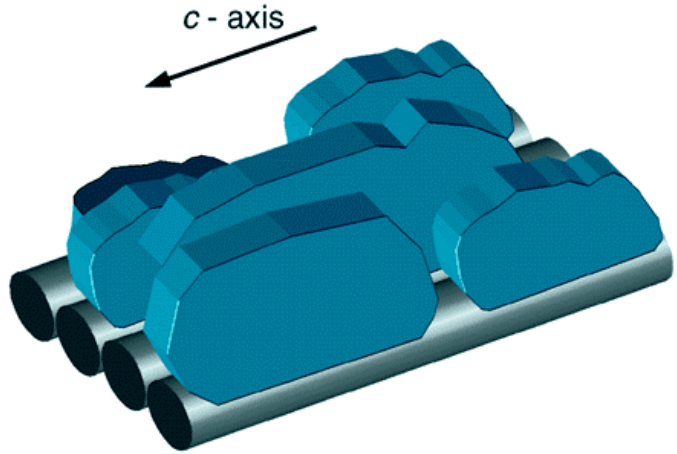


Provided by Dr. Tony Tomsia, Lawrence Berkeley National Laboratory (LBNL)

NORTHWESTERN UNIVERSITY

Samuel Stupp, Ph.D.





Jeffrey D. Hartgerink, Elia Beniash, Samuel I. Stupp
Science Nov 23 2001: 1684-1688

pH-induced self-assembly of a peptide-amphiphile makes a nanostructured scaffold (micelle) reminiscent of extracellular matrix. The structural integrity of the nanofibers is controlled by reversible cross-linking. The alignment of crystals of hydroxyapatite, directed by the nanofibers, forms a composite material that mimics the alignment of hydroxyapatite on collagen fibrils in bone.

UNIVERSITY OF WASHINGTON

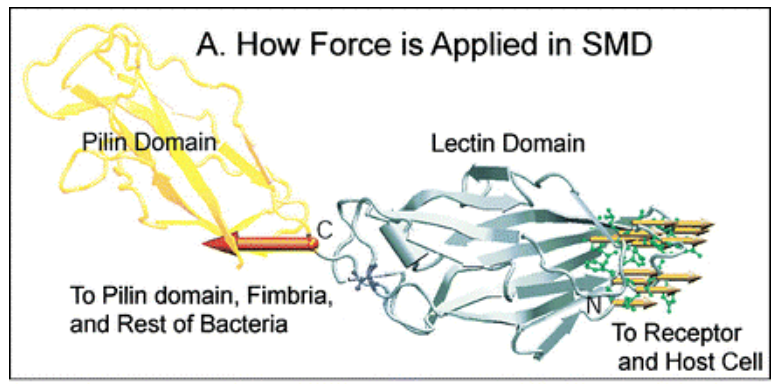
Center of Excellence in Genomic Science

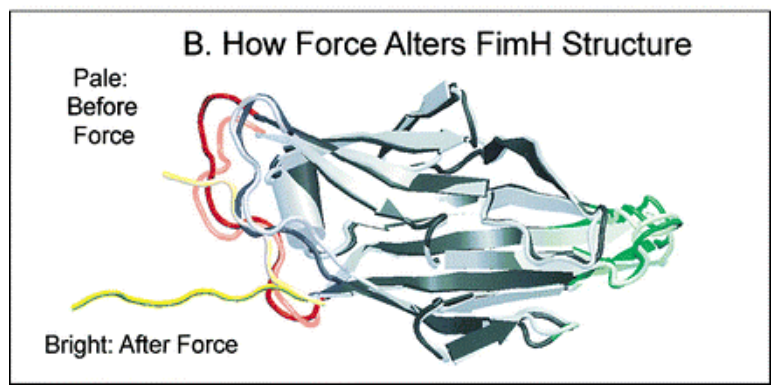
Viola Vogel, Ph.D., Deirdre Meldrum, Ph.D.

Elucidating nature's design principles

Steered Molecular Dynamics simulation of change in protein structure when force is applied to a bacterial cell bound to an erythrocyte. This study provides "insights into the structural mechanisms by which proteins can act as force sensors and undergo a functional switch when subjected to mechanical force *in vivo*. This information … has the potential to be exploited for medical and technological applications."

W. Thomas, et al., Cell, Vol 109, 913-923, June 2002





NIH INITIATIVES IN NANOTECHNOLOGY

Some current NIH programs under which nanotechnology research may be supported:

- Bioengineering Research Grants (BRG's)
- Bioengineering Research Partnerships (BRP's)
- Bioengineering Nanotechnology Initiative (SBIR)
- Nanoscience and Nanotechnology in Biology and Medicine (R01,R21)
- Mentored Quantitative Research Career Development Awards (K25)
- Unsolicited grants and solicitations from many Institutes and Centers

BIOENGINEERING RESEARCH SUPPORT AT NIH

Bioengineering Nanotechnology Initiative (SBIR)

- Nanotechnology is emerging as a field critical for enabling essential breakthroughs that may have tremendous potential for affecting biomedicine.
- Encourages team approach to nanotechnology research
- Phase I up to two years, $200,000 per year
- Phase II up to three years, $400,000 per year
- Applications Receipt per SBIR:
  April 1, August 1 and December 1
- Competes with other SBIR applications
- http://grants.nih.gov/grants/guide/pa-files/PA-02-125

BIOENGINEERING RESEARCH SUPPORT AT NIH

NEW

Nanoscience and Nanotechnology in Biology and Medicine

- Nanotechnology is emerging as a field critical for enabling essential breakthroughs that may have tremendous potential for affecting biomedicine.
- Encourages team approach to nanotechnology research
- R01 (research project)
- R21 (exploratory/developmental) if little preliminary data and potential for groundbreaking impact. Up to 3 years, up to $125,000 per year direct cost
- Review panels dedicated to this program announcement
- Application Receipt: February 18 and August 18
- http://grants.nih.gov/grants/guide/pa-files/PAR-03-045

(in effect through 2006)

NANOTECHNOLOGY RESEARCH AT NIH

Nano Science and Technology: NIH priorities

Examples (not intended to be exhaustive):

- development of spectroscopic tools (e.g., scanning probe methods, quantum dot probes, NSOM, force spectroscopy) and computational methods for nanoscale research on cellular processes for structure analysis and for the extraction of quantitative information from biological nanoscale materials and machines.
- design of artificial nanostructures that could be used within the cell as replacements for defective naturally-occurring nanostructures or to serve other therapeutic purposes not found in normal cells.
- development of novel synthetic methods for generation of functional biomimetic nanostructures characterized by precisely defined architectures for use in the study of biology, disease diagnosis, or therapy.

Nano Science and Technology: NIH priorities

Examples (continued):

- development of nanopatterned substrates on programmable surfaces for the capture, maintenance, and expansion of therapeutically useful cells, and to improve understanding of the role of mechanical forces in cell signaling processes.
- use of nanoscience and nanotechnology approaches for controlling interfaces between prosthetic and extracorporeal devices and tissues.
- studies on the integration of active biological molecules such as molecular motors and membrane pumps with engineered systems to create “living” machines for use in the study of biology, disease diagnosis, or therapy;
- develop ability to integrate across length domains to incorporate nanotechnologies in functional devices for biomedical applications.

Oct. 5, 2003

- Technology Development for Biomedical Applications: Phased Innovation Award (R21/R33) - PAR-02-091 Application Receipt date: June 1, and October 1 annually, ending March 1, 2005
- Role of Musculoskeletal Microvasculature in Fitness and Disease - PA-02-104 - Application Receipt date: February 1, June 1, October 1, ending July 30, 2005

Current NIH Nanoscience and Nanotechnology Research Funding Opportunities:

- Bioengineering Nanotechnology Initiative (SBIR) - Application Receipt date: April 1, August 1 and December 1
- Nanoscience and Nanotechnology in Biology and Medicine - Application Receipt date: February 18 and August 18
- Bench to Bedside Research on Type 1 Diabetes and its Complications - Application Receipt date: February 26, 2003
- Small Business Biodefense Program - Application Receipt date: April 1, August 1, December 1, ending Aug. 2, 2005
- Development of Cell-Selective Tools for Studies of the Bladder, Prostate, and Genitourinary Tract - Application Receipt date: February 1, 2004; February 1, 2005
- NINDS Exploratory/Developmental Projects in Translational Research - Application Receipt date: February 1, June 1, October 1, ending July 31, 2005

Current BECON Bioengineering Training Opportunities:

- Mentored Quantitative Research Career Development Award - PA-02-127 - Released July 10, 2002
- NSF/NIH Scholar-in-Residence Program (NSF 98-48)
- Biomedical Engineering Summer Internship Program

Current NIH Bioengineering Training Opportunities:

- Training Opportunities in Bioengineering and Bioinformatics at the National Institutes of Health (NIH) & the National Science Foundation (NSF) - by Career Level
- NIH Research Training Opportunities

Information on Funded Grants and Projects for NIH/BECON Program Announcements:

BIOENGINEERING RESEARCH SUPPORT AT NIH

Single Molecule Detection and Manipulation

- R01 Awards PA-01-049 February 1, June 1, October 1
- http://grants.nih.gov/grants/guide/pa-files/PA-01-049.html
- SBIR/STTR Awards PA-01-050 April 1, August 1, December 1
- http://grants.nih.gov/grants/guide/pa-files/PA-01-050.html
- basic research on detection and manipulation of single molecules to provide fundamentally new information about biological processes for understanding cellular function; real time measurements of single molecules in living cells
- development of the collateral chemistry and instrumentation
- new tools and strategies; refinement of current methods
- NIGMS, NIDCD, NHGRI
- single molecule detection and manipulation workshop report: http://www.nigms.nih.gov/news/reports/single_molecules.html

BIOENGINEERING RESEARCH SUPPORT AT NIH

Functional Tissue Engineering of Musculoskeletal Tissues

- To stimulate innovative research that will enhance our understanding of functional tissue engineering of musculoskeletal tissues (articular cartilage, ligaments, tendons, bone, meniscus, intervertebral disc and skeletal muscle).
- Research Project (R01) mechanism
- Application Receipt: February 1, June 1 and October 1
- NIAMS, NICHD, NIDCR
- http://grants.nih.gov/grants/guide/pa-files/PA-02-014.html

BIOENGINEERING RESEARCH SUPPORT AT NIH

Small Business Biodefense Program

- NIAID has identified specific products for biodefense that are of highest priority for rapid development. Specific examples are given in areas including therapeutics, vaccines, diagnostics, adjuvants/ immunostimulants, and selected resources.
- SBIR and STTR mechanisms
- scle). Application Receipt: February 1, June 1 and October 1
- Phase I applications up to 2 years and $500,000 total cost per year.
- Phase II applications up to 3 years and $2M total cost per year.
- NIAID
- http://grants.nih.gov/grants/guide/pa-files/PAS-02-149.html

BIOENGINEERING RESEARCH SUPPORT AT NIH

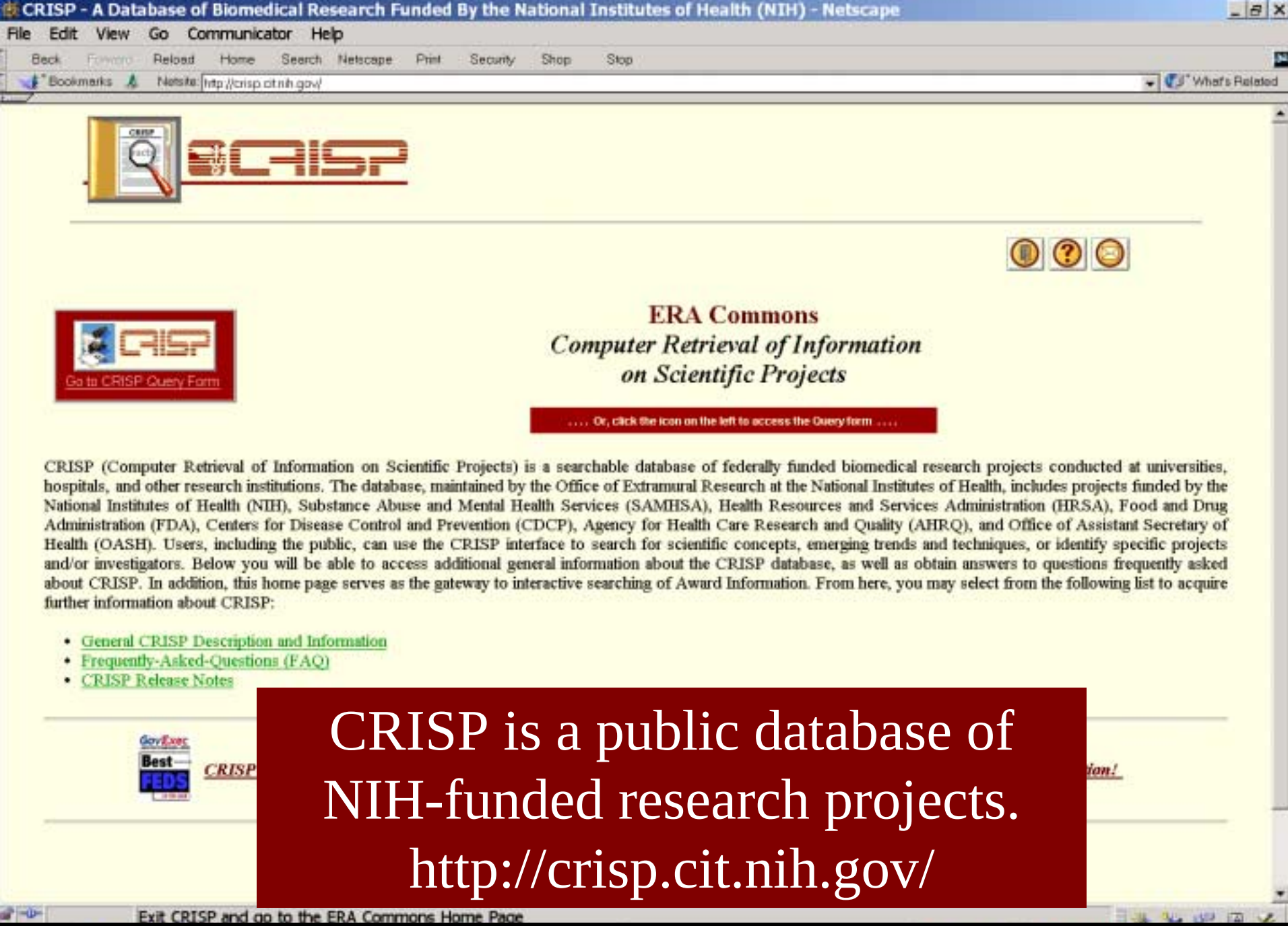
Novel Approaches to Corneal Tissue Engineering

- To explore new approaches that could lead to enhanced engineering of corneal tissues, includes studies of early developmental processes to delineate the interactions between individual corneal tissue layers, the biomechanical properties of the stroma, cellular control of matrix deposition, control of corneal growth and maturation, and studies of synthetic replacement materials.
- To attract new talent. Multidisciplinary approaches encouraged.
- Research Project (R01) mechanism
- Application Receipt: February 1, June 1, and October 1
- NEI
- http://grant.nih.gov/grants/guide/pa-files/PA-02-053.html

BIOENGINEERING RESEARCH SUPPORT AT NIH

Technology Development for Biomedical Applications

- To develop innovative (1) new and improved instruments or devices, (2) new methodologies using existing instruments, or (3) software to be used in biomedical research
- Phased Innovation Award (R21/R33) – staff review to proceed to development phase).
- Application Receipt: June 1 and October 1, annually
- NCRR, NIBIB, NHGRI
- http://grants.nih.gov/grants/guide/pa-files/PAR-02-091.html



CRISP is a public database of NIH-funded research projects.
http://crisp.cit.nih.gov/

http://www.becon.nih.gov/becon.htm

http://crisp.cit.nih.gov/

http://www.nano.gov

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