SAND2007-1944P

Welcome to the Nanotechnology Future!

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Sandia is a Multiprogram Laboratory Operated by Sandia Corporation,
a Lockheed Martin Company, for the United States Department of Energy
Under Contract DE-ACO4-94AL85000.

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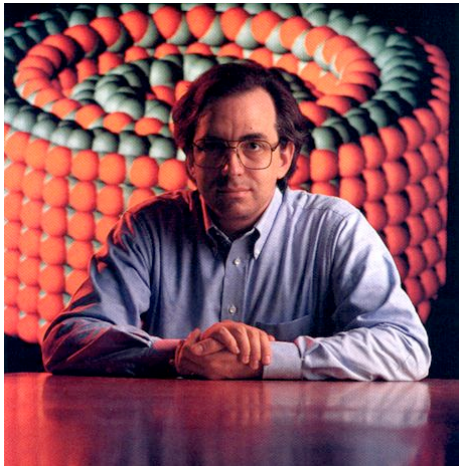
The Scary Future!

*"Nanotechnology will alleviate world hunger, clean the environment, cure cancer, guarantee biblical life spans or concoct super weapons of untold horrors."**

Nano-aliens fight human warfare



Nano-assemblers that will be able to copy and duplicate themselves, self-assemble into anything, including human body parts, in seconds. These nano-assemblers may take control of human race.

Trains and airplanes powered by nano-machines

* Scientific American, Sept., 2001.

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Nanotechnology is showing up in unexpected places

"Nanotech takes new fabric past drip-dry into drip-free"

**USA Today Wednesday, January 10, 2001*

By Kevin Maney

By this summer, you'll be able to have nanotechnology in your pants. Oh, baby.

Really – you'll walk into a store and see pants tagged with the brand name Nano-Dry or Nano-Care, each made with nanotechnology created by Nano-Tex, a 14-person company that's 51% owned by fabric giant Burlington Industries. This might be the first time that nanotech shows up in a mass-market consumer product – a landmark of sorts. You could even say these will be the first true smarty-pants…

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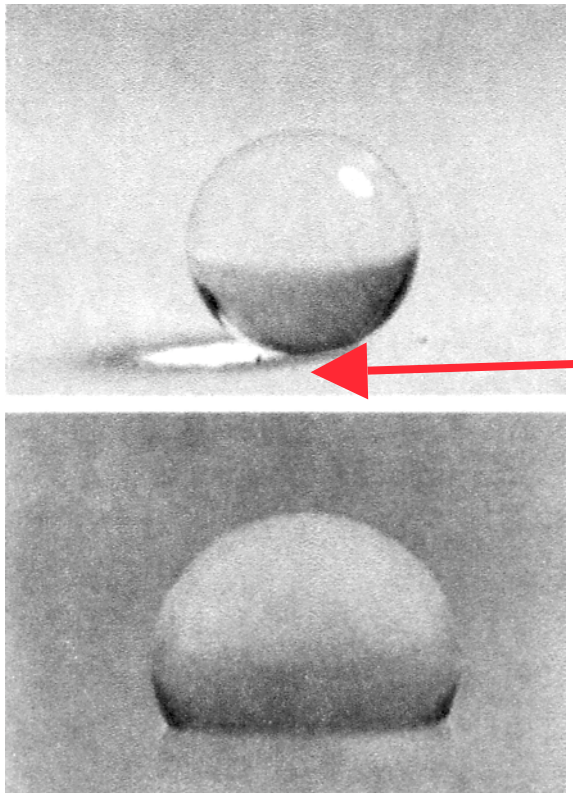
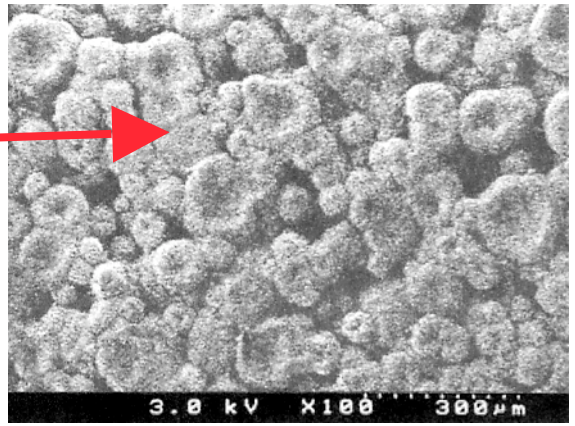
Nice pants, thanks to nanoscience

Water Drop on
Fractal Surface



Nano-Roughness
Minimizes Contact



Water Drop on
Smooth Surface

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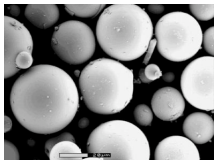
The scale of things Natural…

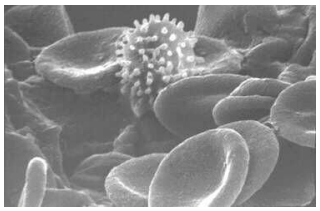
Ant
~ 5 mm

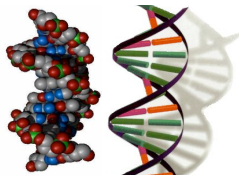
Human hair
~ 10-50 μm wide



Fly ash
~ 10-20 μm

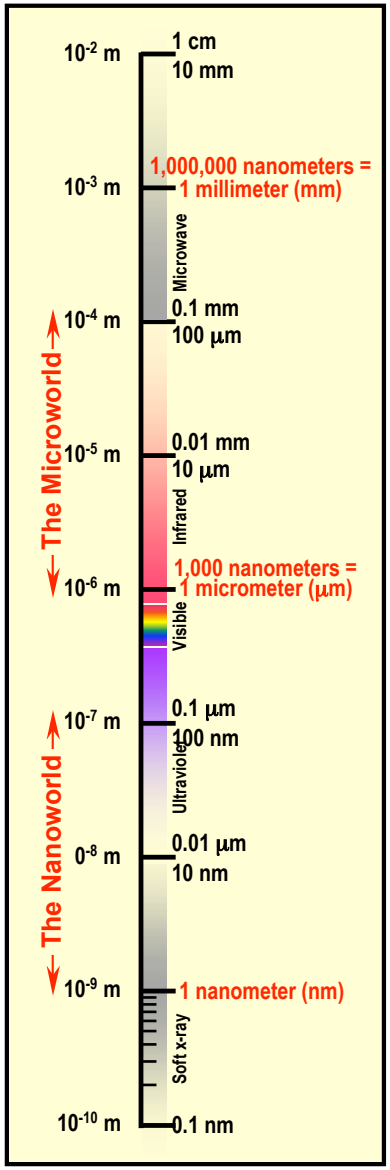
Red blood cells with white cell
~ 2-5 μm





DNA
~2 nm diameter

Atoms of silicon
spacing ~0.2 nm



10^{-3} meter

10^{-6} meter

10^{-9} meter

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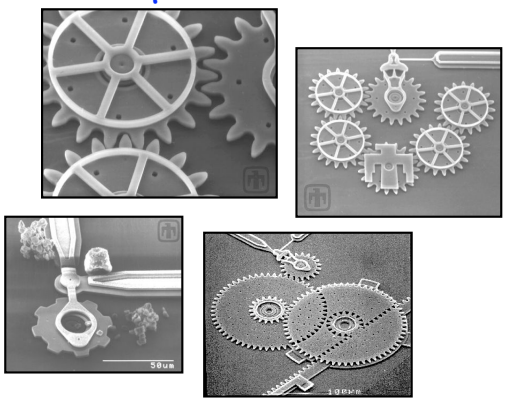
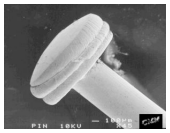
The scale of things Man-made…

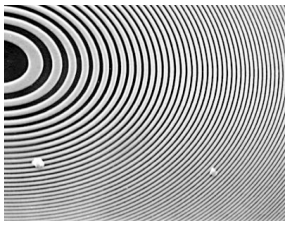
Micro-Machines
10 -100 μm wide

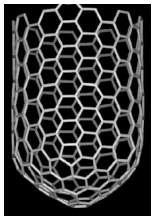




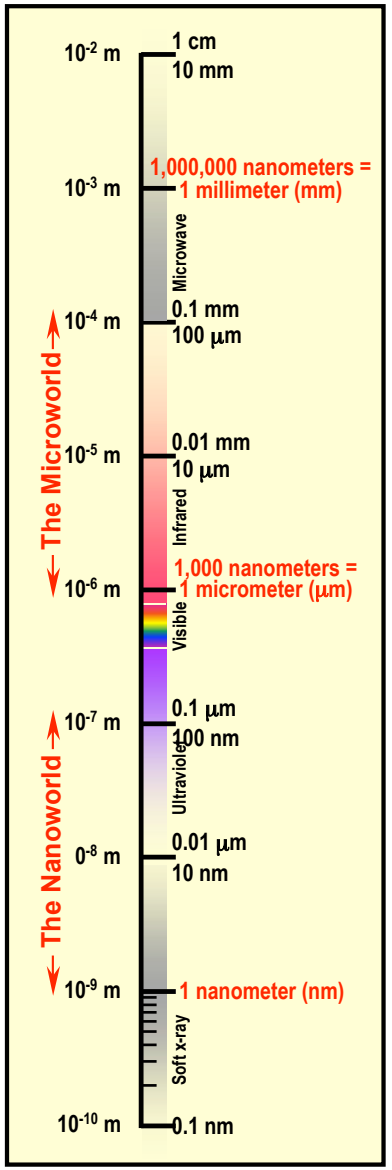
Head of a pin
1-2 mm

X-ray "lens"
ring spacing ~35 nm





Carbon nanotube
~2 nm diameter



10^{-3} meter

10^{-6} meter

10^{-9} meter

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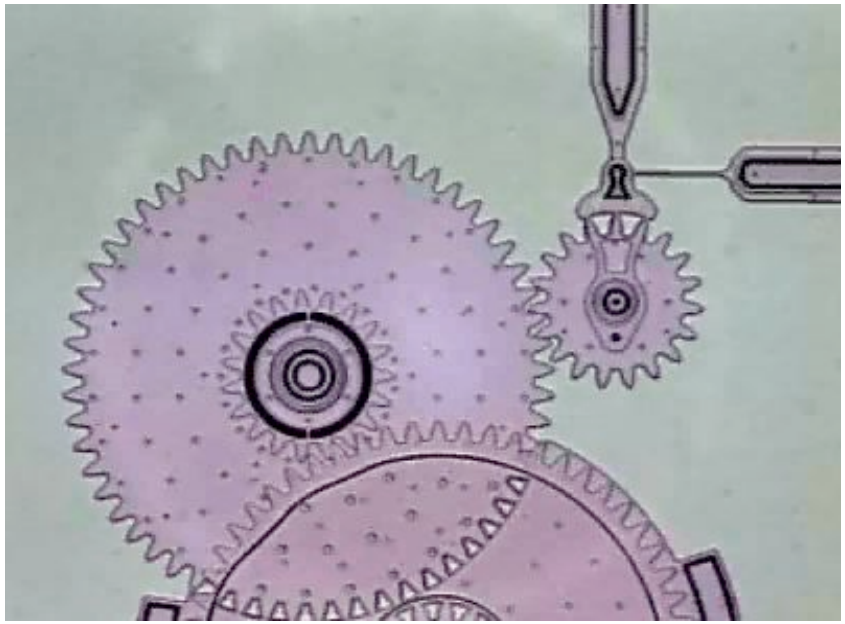
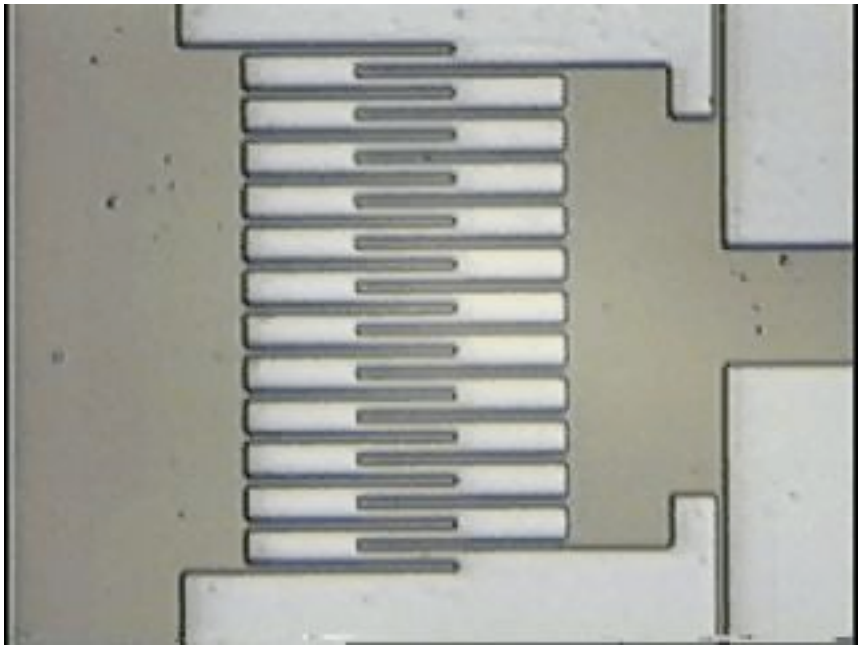
Examples of micro-machines





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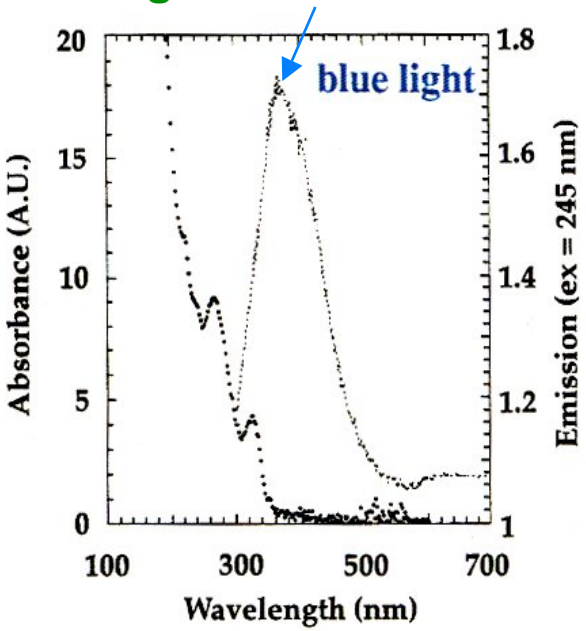
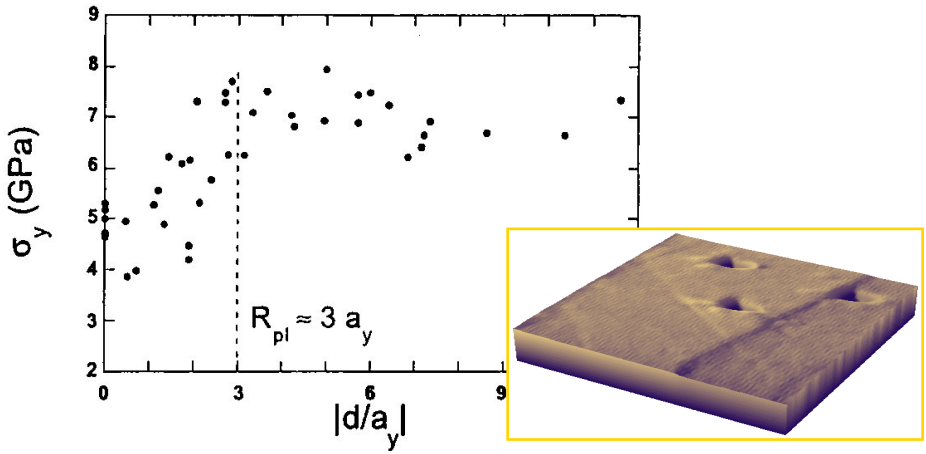
Ordinary materials can behave differently at the nano-scale

Light from Silicon



Steel-like strength from gold



New phenomena from…

- Surfaces and interfaces
- Quantized effects

Lead to…

- New physical effects
- New chemistry
- New mechanical properties

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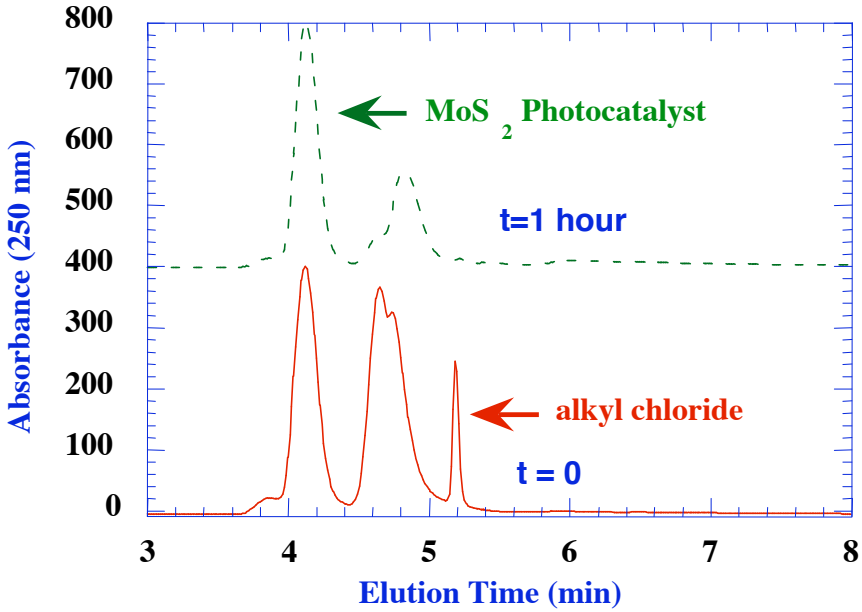
Semiconductor nano-crystals use sunlight to clean up pollutants



MoS_2 nanocrystals photo-oxidize an alkyl chloride using only visible light

- **Environmental remediation**
- **Solar photocatalysis/fuel production**

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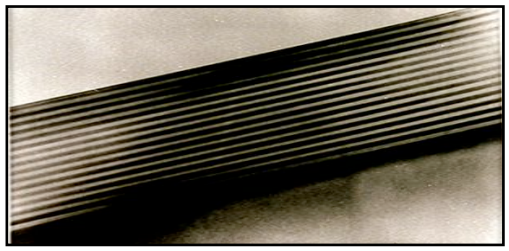
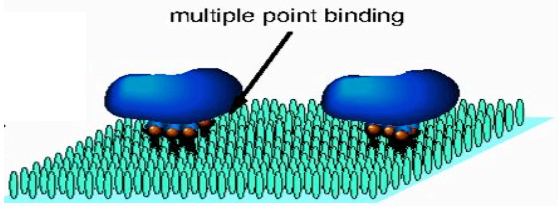
Integrated Nanotechnology will impact our world

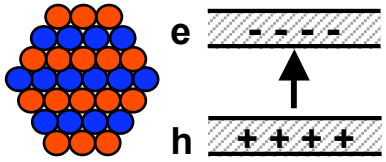
Energy

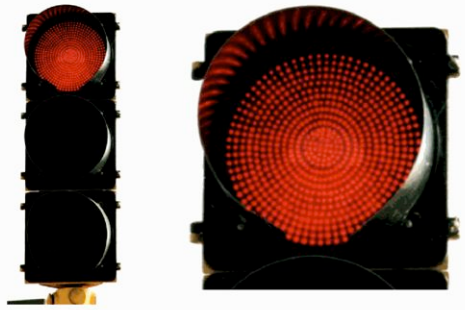


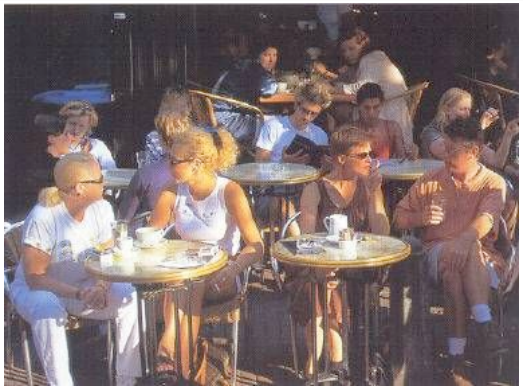
Bio-Medical



Environment







Connecting scientific disciplines and length-scales is key to success

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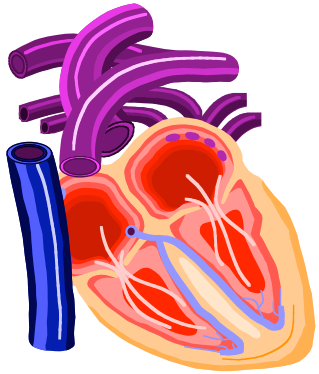
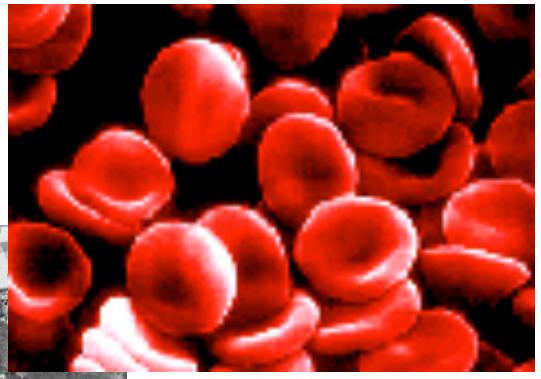
You are the best example of "integrated nanotechnology"

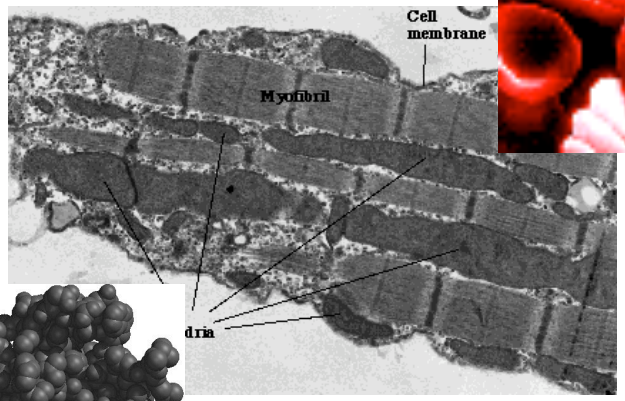
Integrated structures combine multiple length scales and functions.



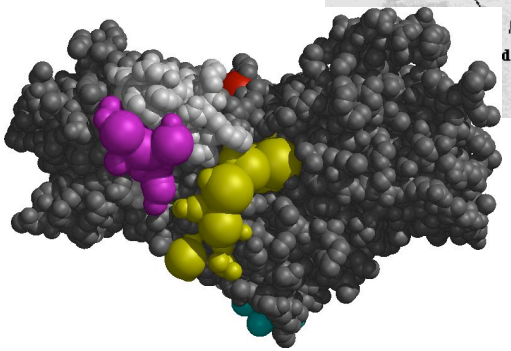
Organs and Tissues



Cells



Sub-cellular mechanical structure



Molecules and Chemical Pathways

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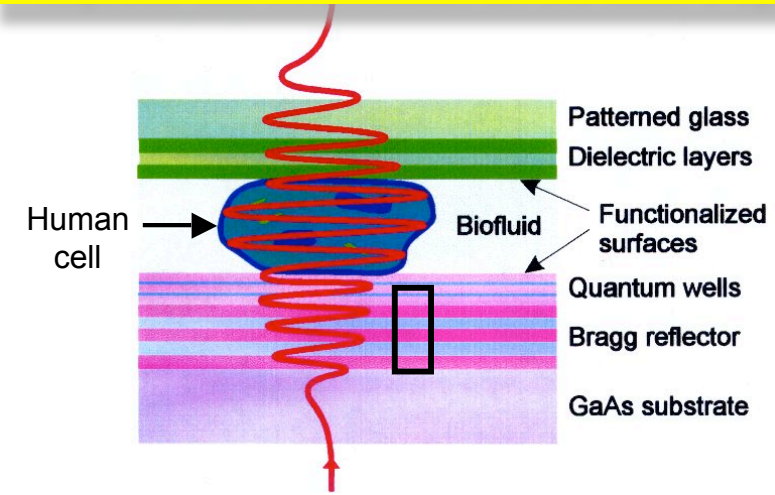
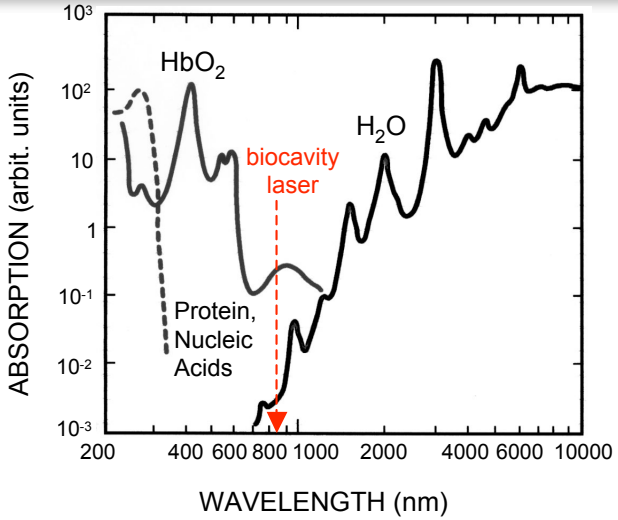
The BioCavity Laser combines nano and micro technologies

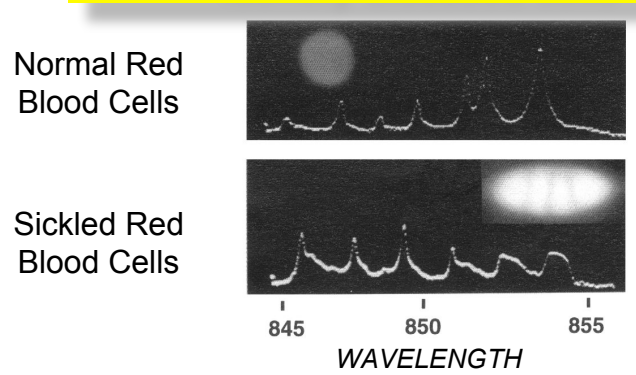
Biological cells form part of a semiconductor laser and impress cell information on the laser's optical output



The semiconductors are tailored to emit where the cells are transparent



Unique emission signatures identify diseased cells



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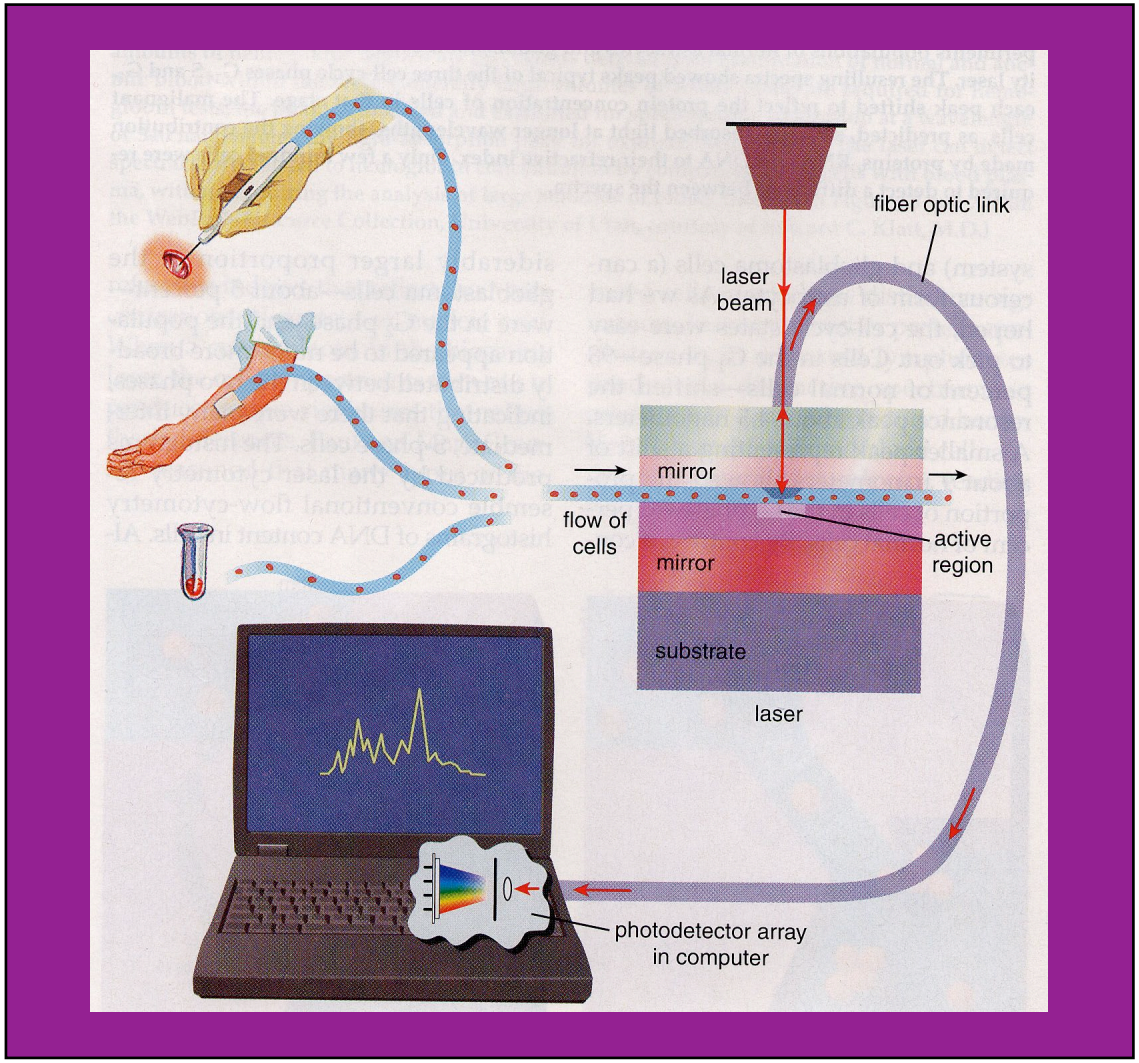
Biocavity laser technology could combine detection and treatment



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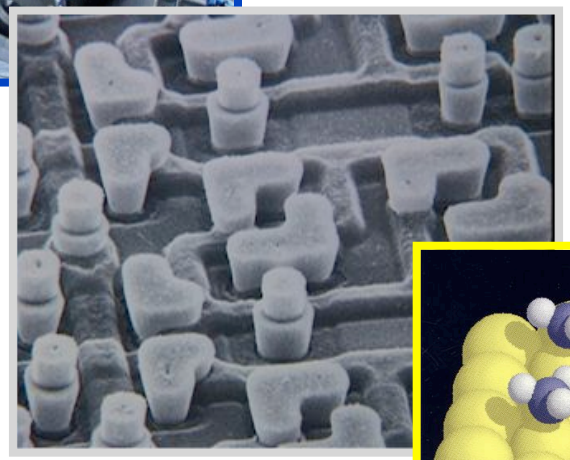
How is nano-technology different from micro-technology?

Conventional Machines

Build and assemble

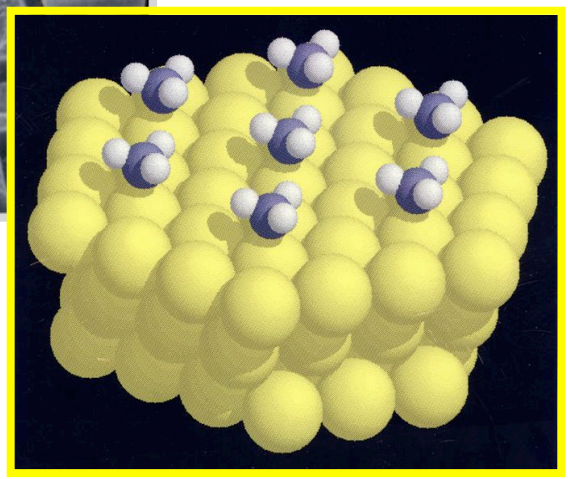
(m - mm)



Microelectronics

Top down - build in place

(10 - 0.1 µm)



Nanotechnology

Bottom up - self assembled

(1- 100 nm)

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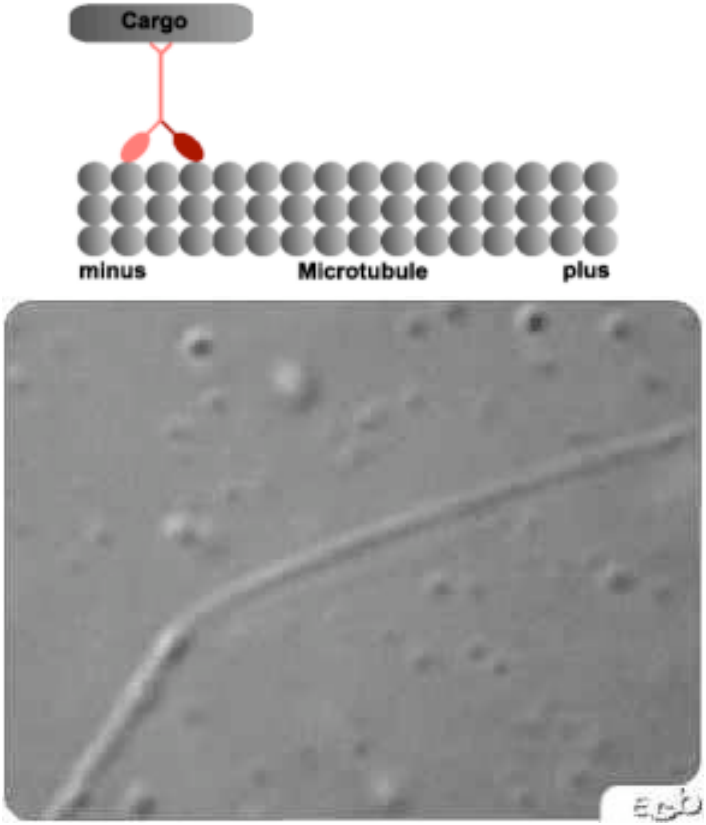
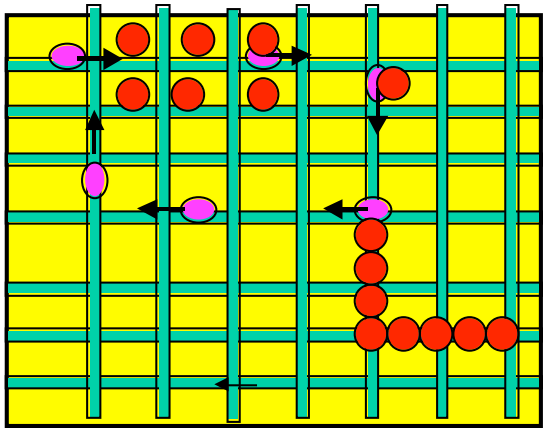
How Nature moves things…

Directed translation of molecular cargo as a result of energy consumption;
Nature's solution to diffusion problems.





*From: Alberts et al. (1998)
"Essential Cell Biology."

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Center for Integrated Nanotechnologies

Sandia National Laboratories • Los Alamos National Laboratory

- Highly collaborative U.S. Dept. of Energy User Facility
- Focused on nanoscience integration
- Access to tools and expertise
- Pre-competitive and proprietary research options

"One scientific community focused on nanoscience integration"

CINT Core and Gateway Facilities are open for business

Core Facility in Albuquerque

CINT Gateway to Sandia
Nanomaterials/Microfabrication

CINT Gateway to Los Alamos
Nanomaterials/Biosciences

Begin Operations	**April 2006**
Fully Operational	**May 2007**

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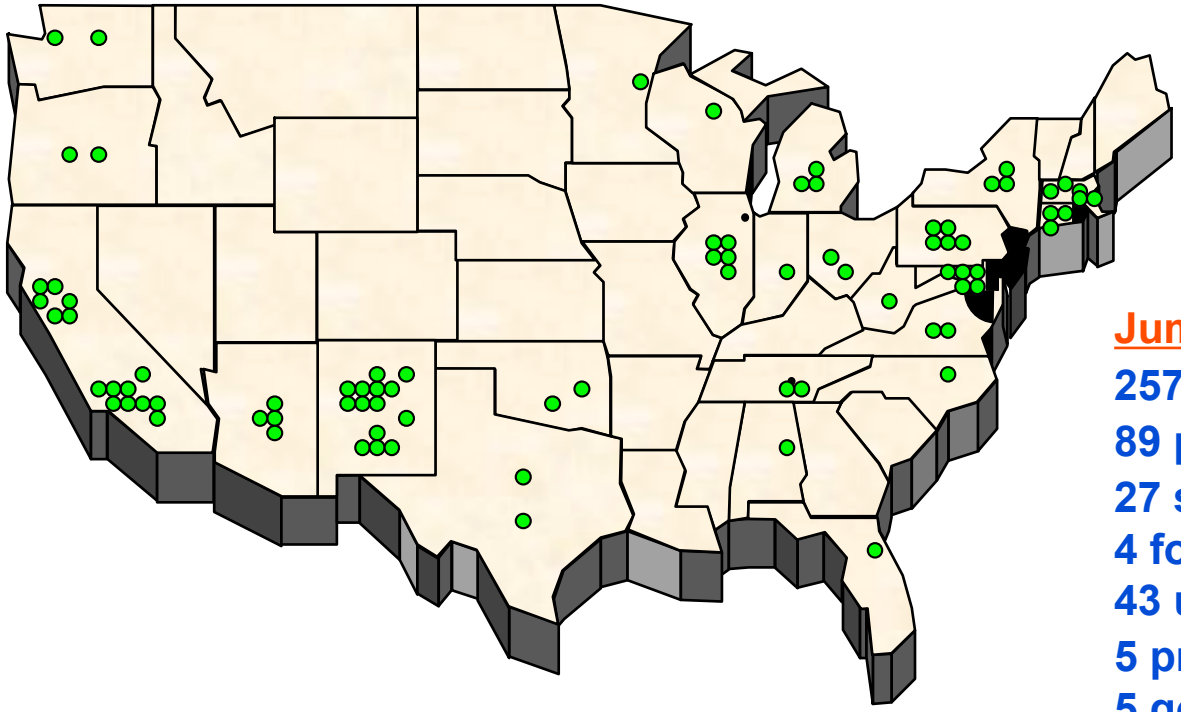
Users are already working at CINT



Jump-start User Projects

257 requests (2003-05)
89 projects approved
27 states
4 foreign countries
43 universities
5 private-sector
5 government labs

2006 Call-for Proposals

175 requests
>120 approved (others pending)

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The nanotechnology future is taking shape in New Mexico!

Come visit us on the web!

http://CINT.sandia.gov **or** http://CINT.lanl.gov

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