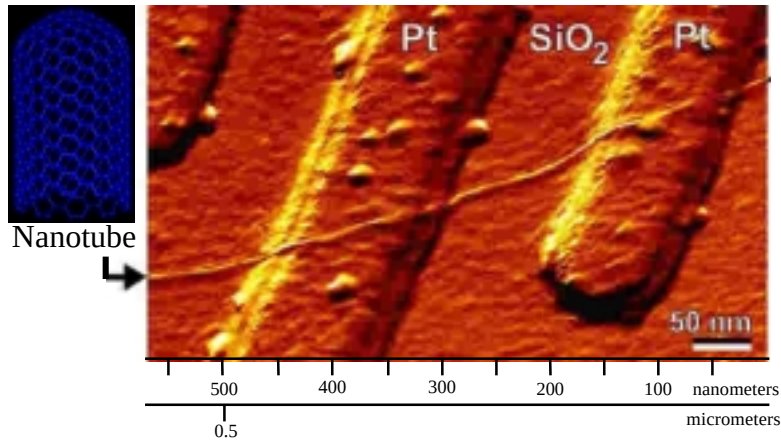
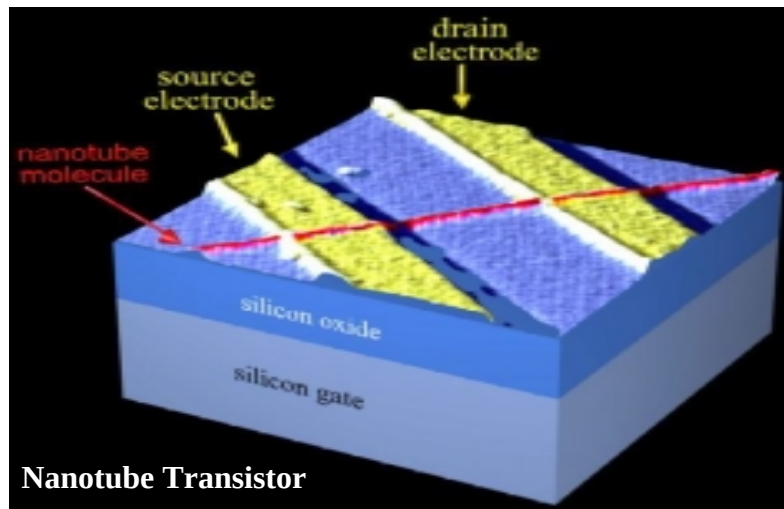
Nanoscale Science, Engineering, and Technology
Building Structures One Atom at a Time

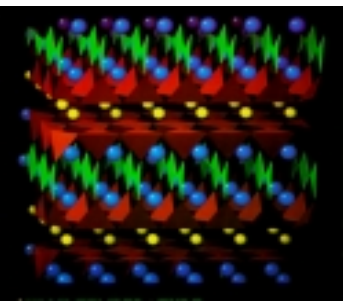
- Tailor materials at the nanoscale for desired structure/function properties
  - *Materials with enhanced physical, mechanical, optical, electrical, tribological, or catalytic properties*
  - *Materials with the ability to self assemble, self repair, sense and respond to the environment*
- Long-term, high-risk, interagency activity -- a unique instance of common scientific and technological frontiers
- Combines expertise in materials sciences, chemistry, physics, biology, engineering, and computation
- Expected are technological developments to rival the impact of the transistor



Nanotubes exhibit unique quantum-wire properties which derive from their nanometer diameter and the special electronic structure of graphite. Nanotube transistors have recently been fabricated. These three-terminal devices consist of an individual semiconducting nanotube on two metal nanoelectrodes with the substrate as a gate electrode.



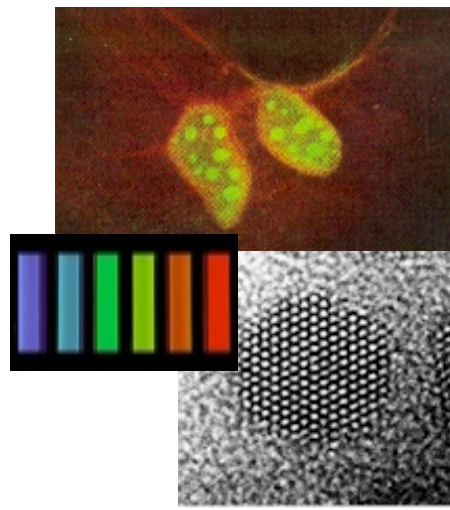
Nanoscale Science, Engineering, and Technology
The Challenges

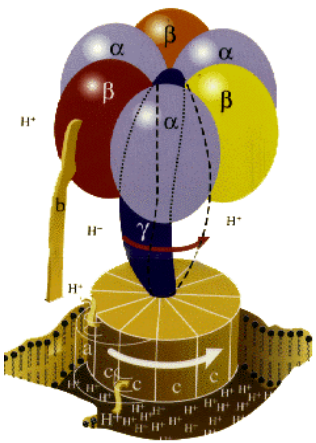


Superconductivity, a collective effect, enables materials to conduct electricity without loss.

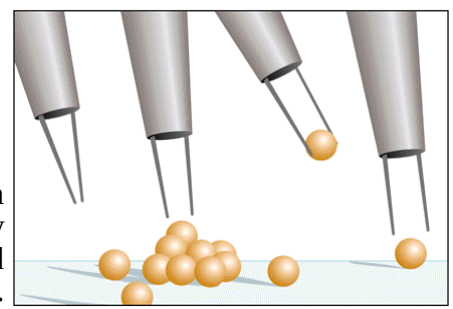
- Attain a fundamental understanding of nanoscale phenomena, particularly collective phenomena
- Design and synthesize materials at the atomic level to produce materials with desired properties and functions
- Understand the processes by which living organisms create materials and functional complexes to serve as a guide and benchmark for synthesis
- Create experimental tools and theory/modeling/simulation tools to drive the nanoscale revolution

Cadmium selenide nanocrystals linked to biomolecules light up a cell's actin filaments (red) and nucleus (green).





Enzymatic mechanism of ATP synthesis, a molecular rotator that can be incorporated into manmade structures



Tweezers composed of carbon nanotubes grab a particle only about 500 nm in diameter and move it to a desired location.