

Molecular Nanotechnology
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What is Nanotechnology?

- Mainly the size defines most of what nanotechnology is.
- Less than a nanometer (or a billionth of a meter).
- The 1950's and 1960's started the era where electronics industry started making things smaller.
- Transistors and Integrated Circuits(IC's) shrank over the next few decades.
- By the 1980's a limit to miniaturization was predicted.
- Focus turned to atoms and molecules
- Geneticists discover genetic information stored in each cell called DNA
- Thus the roots of nanotechnology come from three lines – atomic physics, chemistry, and electronics.
- Finally in the 1980's this new field of study received the name – nanotechnology.

Building blocks of Nanotechnology

-Buckyballs, Nanotubes, DNA, Scanning tunneling Microscope, Micromachines, Quantum Dots

Buckyballs

- Buckminsterfullerenes commonly known as buckyballs
- In 1984 Richard Smalley, Robert Curl, and Harold Kroto investigated an interesting molecule of 60 linked carbon atoms.
- These atoms were worked into soccer ball shapes called “fullerenes”.
- Unique electrical and chemical properties

Nanotubes

- NASA created these carbon nanotubes
- The fibers conduct electricity incredibly well
- These nanotubes can be created in large numbers and at a relatively low price
- Mixed with plastics nanotubes become incredibly strong and light
- Common uses that are mass produced are car parts, tennis rackets, and batteries
- These are incredibly practical because of their small and light size
- How well they conduct electricity, and can disperse static charges

DNA or Deoxyribonucleic acid

-The early 1990's brought the ability for geneticists to copy DNA

- This allowed for construction of new chemicals and tiny machines
- Professor Nadrian Seeman demonstrates a tiny robotic arm

Scanning Tunneling Microscope (STM)

- Incredibly small tip
- It can in essence “feel” individual atoms
- The STM was discovered soon after being made that it could move atoms around
- This new technology of moving atoms changed to atomic force microscopes

Micromachines

-In the early 1990's transistors and chips reached nano-scale

- These techniques were used to create some of the first nano-machines
 - These had actual moving parts
 - One example of this is a guitar string that could be plucked
- Quantum Dots
- A very useful new semiconductor made from silicon
 - These are becoming widely used in experimental biology
 - Can be coated to bind to certain things like RNA
 - Analyzes genetic material far faster than possible before
 - This will hopefully drastically speed up the assessment of diseases

BuckyBalls and Fuel Cells

- Fuel cells based on buckyballs to strengthen carry electrons faster
- Uses a powerful electrolyte membrane with a platinum catalyst
- Still uses methanol which is not legal on planes
- Future outputs could drastically increase battery technologies

Buckyballs and Flash Memory

- A thin layer of buckyballs is expected to replace the dielectric barrier
- This will allow electrons to jump over the barrier at a much lower voltage
- Possibly 5V instead of 12-15V
- Allow for an increased battery lifespan

Quantum Dots (Evidots)

- Unique semiconductor properties
- Allows for a tunable band gap giving unique electrical and optical properties
- Broad range of emission frequencies allows for limitless possibilities
- Allows for broad spectrum radiation detection

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