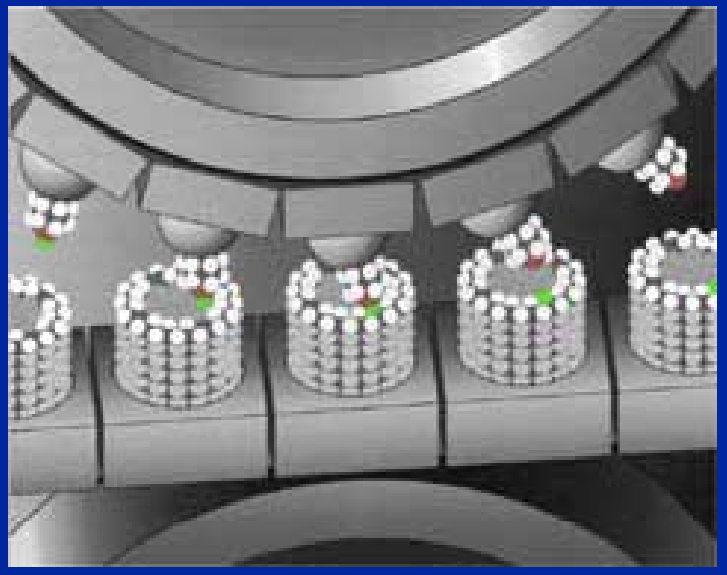
Nanotecnología y sostenibilidad.

Cuntis, 7 de Marzo de 2009



José Rivas
Instituto de Investigaciones Tecnológicas. Universidad de Santiago de Compostela.

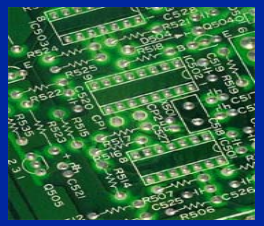
¿Qué es la Nanotecnología?

PREFIJOS DE MEDIDAS

Mili = 10^{-3}

1 Milímetro = 10^{-3} m
1 milésima de metro
1 millón de nanómetros
EL ESPESOR DE 1 €

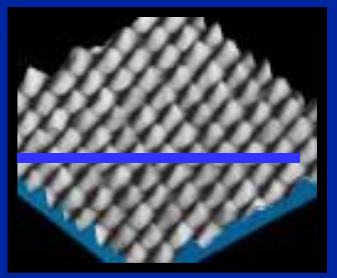
Micra = 10^{-6}



1 Micrómetro = 10^{-6} m
1 millonésima de metro

CHIP

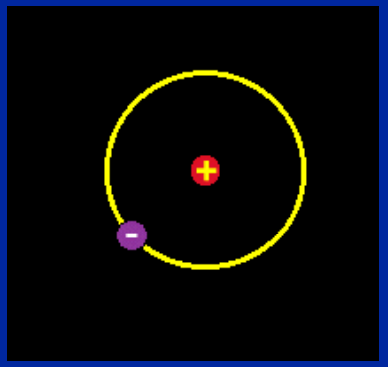
NANO = 10^{-9}



1 Nanómetro = 10^{-9} m
1 mil millonésima de metro

10 ÁTOMOS DE HIDRÓGENO

1 Angstrom = 10^{-10} m
1 billonésima de metro
ÁTOMO DE HIDRÓGENO



Angstrom = 10^{-10} m
Pico = 10^{-12}
Femto = 10^{-15}
Atto = 10^{-18}

NANOCIENCIA Y NANOTECNOLOGÍA: ¿QUÉ SON?

*La **nanociencia** es un nuevo planteamiento centrado en la comprensión y el dominio de las propiedades de la materia a escala nanométrica: un nanómetro (la mil millonésima parte de un metro) viene a ser la longitud de una pequeña molécula.

***La nanotecnología** **trata de la manipulación "controlada" y producción de objetos materiales, instrumentos, estructuras y sistemas a dicha escala. El ámbito de la escala de trabajo que abarca, usualmente va desde 1 a 100 nanómetros.**

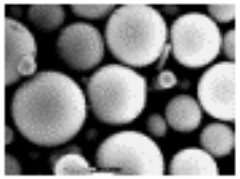
The Scale of Things -- Nanometers and More

Things Natural

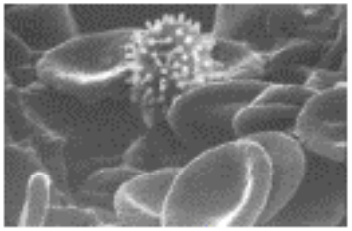
Dust mite
200 µm

Ant
~ 5 mm

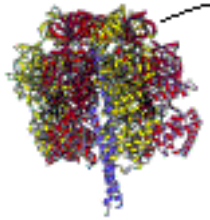
Human hair
~ 10-50 µm wide



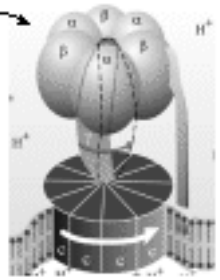
Fly ash
~ 10-20 µm



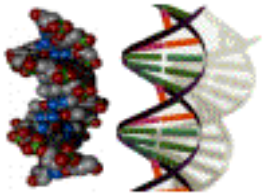
Red blood cells with white cell
~ 2-5 µm



~10 nm diameter

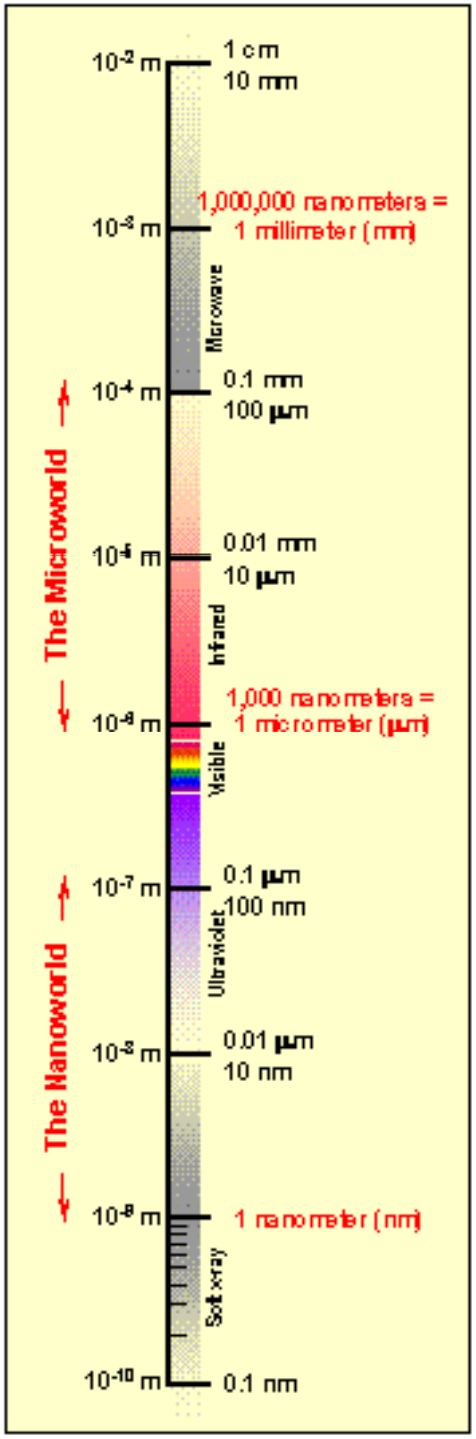


ATPsynthase

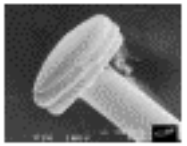


DNA
~2-12 nm diameter

Atoms of silicon
spacing ~tenths of nm

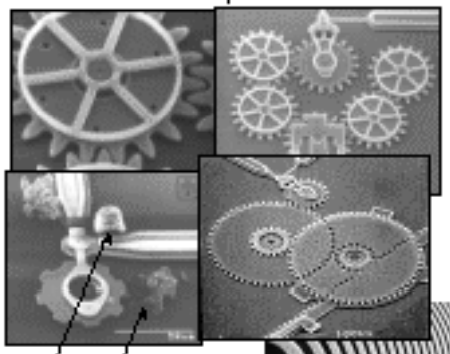


Things Manmade

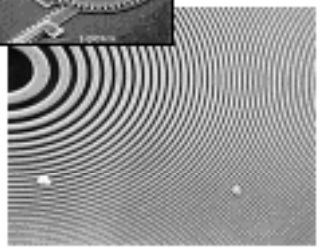


Head of a pin
1-2 mm

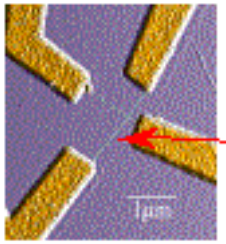
Micro Electro Mechanical devices
10 - 100 µm wide



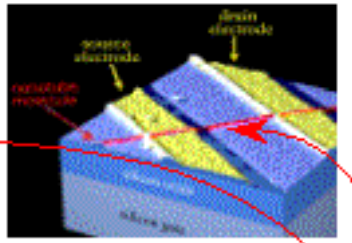
Red blood cells
Pollen grain



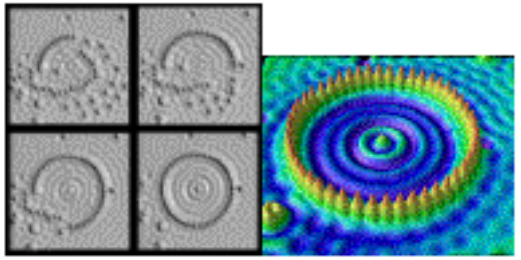
Zone plate x-ray "lens"
Outermost ring spacing
~35 nm



Nanotube electrode

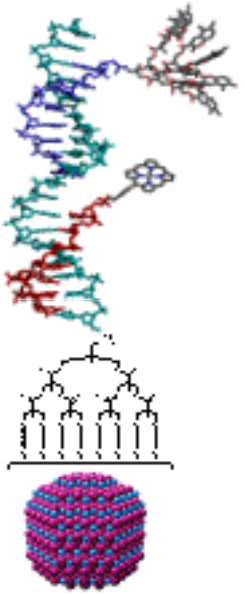


Nanotube transistor

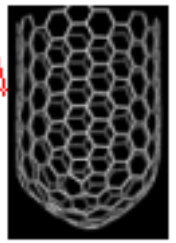


Quantum corral of 48 iron atoms on copper surface
positioned one at a time with an STM tip
Corral diameter 14nm

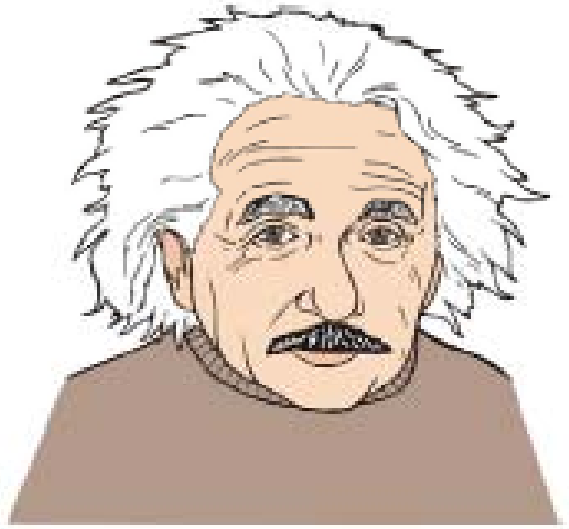
21st Century Challenge



Combine nanoscale building blocks to make novel functional devices, e.g., a photosynthetic reaction center with integral semiconductor storage



Carbon nanotube
~2 nm diameter



¿ Por qué es importante la Nanotecnolgía?

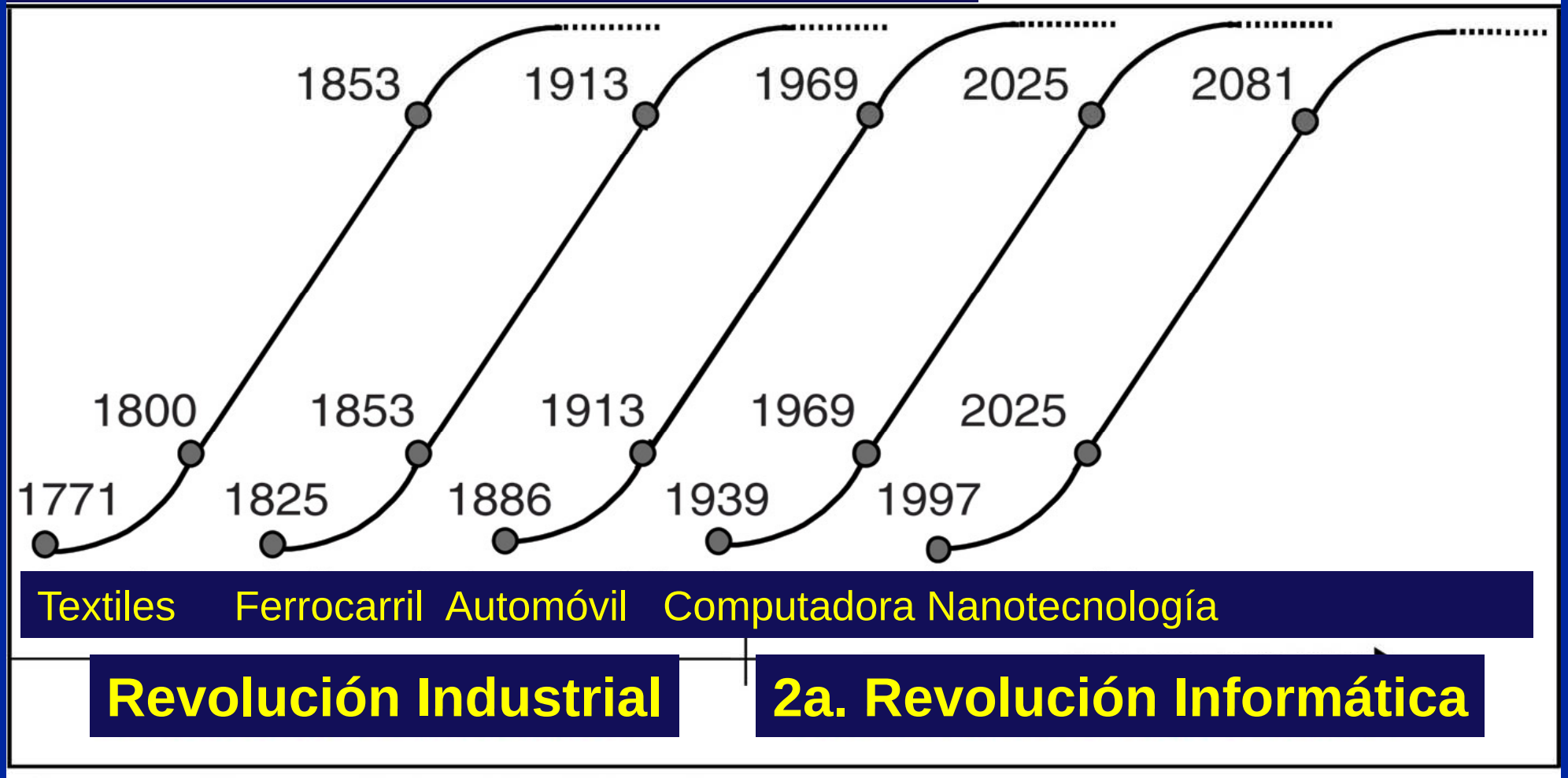
En el futuro, es posible imaginar innovaciones, *fantásticas* en campos tales como:

> Biomedicina y salud.
> Ciencia y tecnología de materiales.
> Tecnologías de la información.
> Fabricación a nanoescala (“top-down”, “botton-up”).
> Fabricación de instrumentos.
> Medio ambiente y seguridad.
> Producción y almacenamiento de energía.

... pero estamos empezando. Para tener éxito, debemos optimizar nuestros esfuerzos.

REVOLUCIÓN NANOTECNOLÓGICA

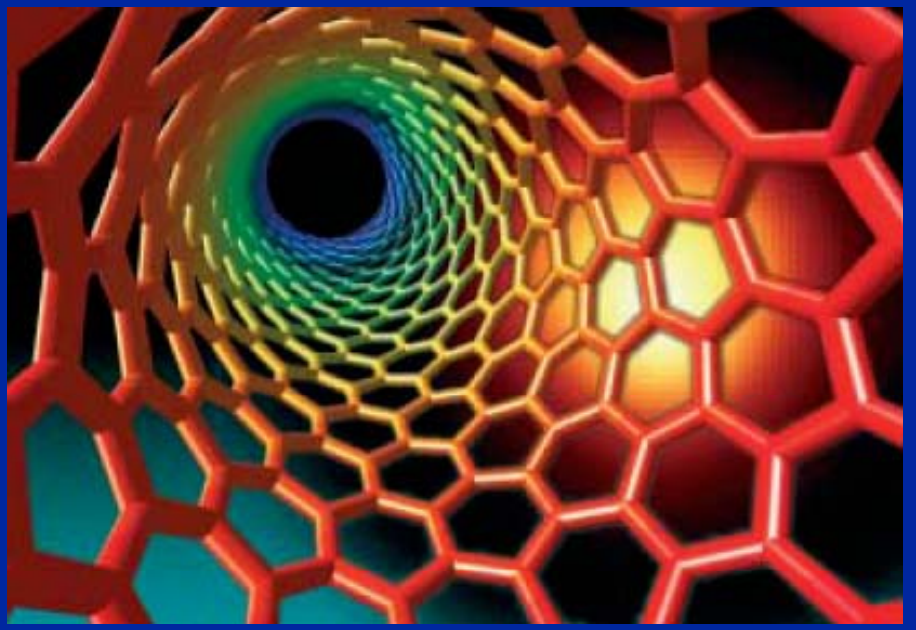
Crecimiento de las Innovaciones

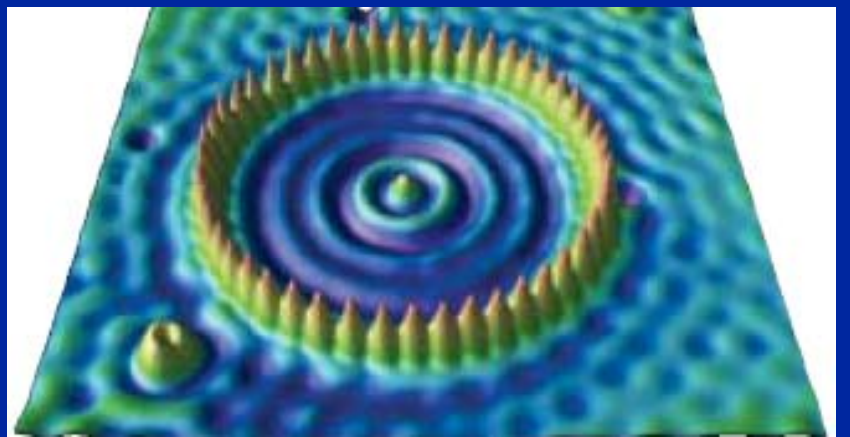


Fuente: Norman Poire Merrill Lynch

Se predice que la Nanotecnología rivalizará con el impacto en el desarrollo producido por el automóvil y la introducción de la computadora personal.

Nanotecnología
para la sociedad



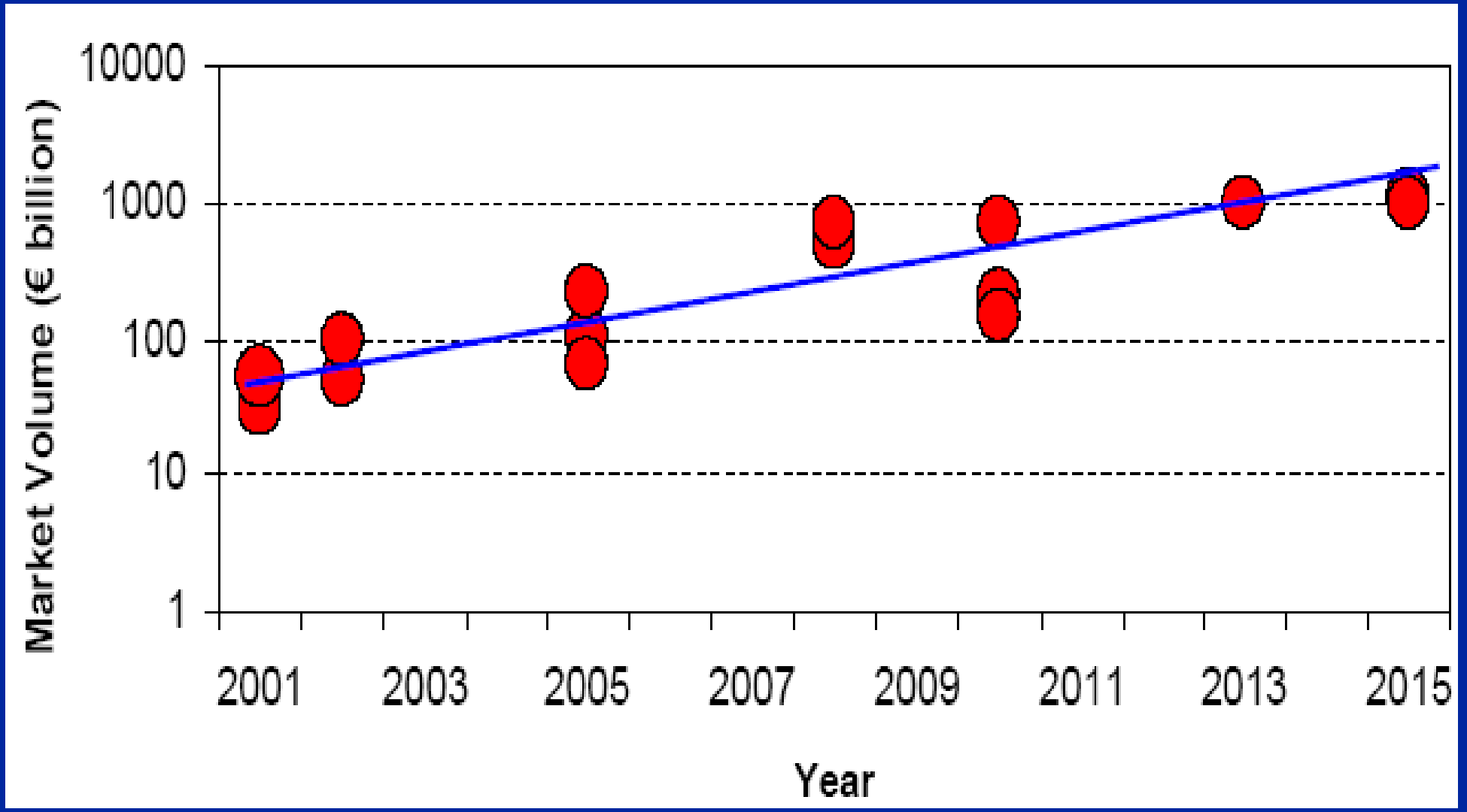


Nanotecnología para la sociedad

Nanotecnología en la vida cotidiana del futuro

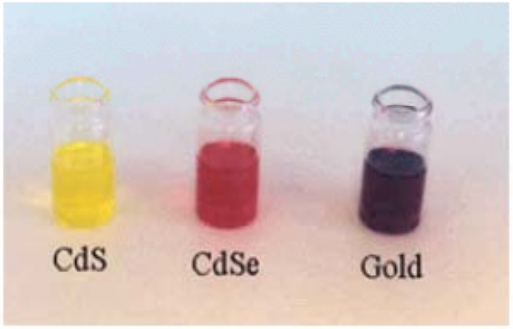
MERCADO MUNDIAL

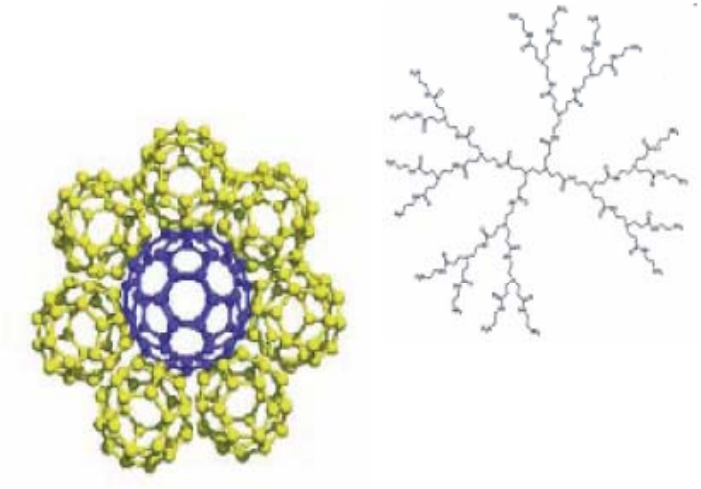
Analistas estiman que el mercado para los productos basados en Nanotecnología podrían superar los cientos de billones de € para el 2010 y posteriormente exceder incluso de un trillón.

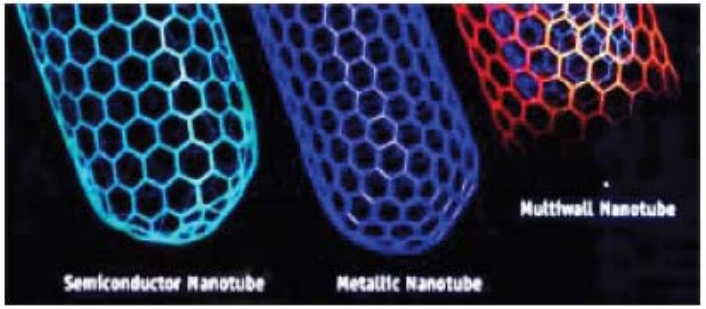


Keep in mind

Nanotechnology does not include just a single material or class of materials



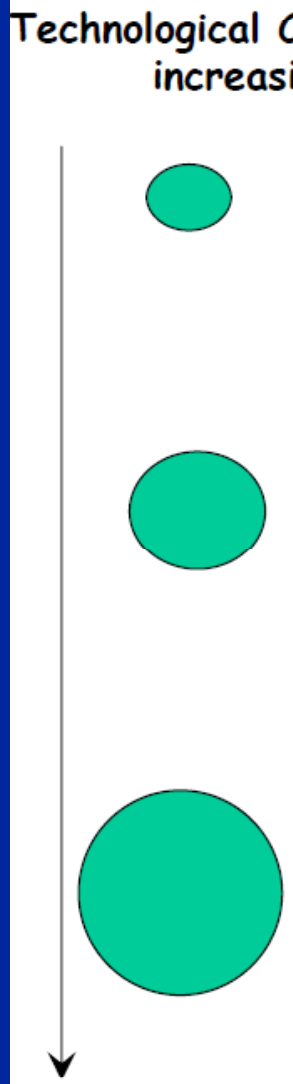




Nanotechnology does not include just a single industry or industrial sector

Nanotechnology converges with other technologies: biotechnology, information technology

Stages of Nanotechnology Development



First Generation ~2001: Passive nanostructures

Nano-structured coatings, nanoparticles, nanostructured metals, polymers, ceramics, Catalysts, composites, displays

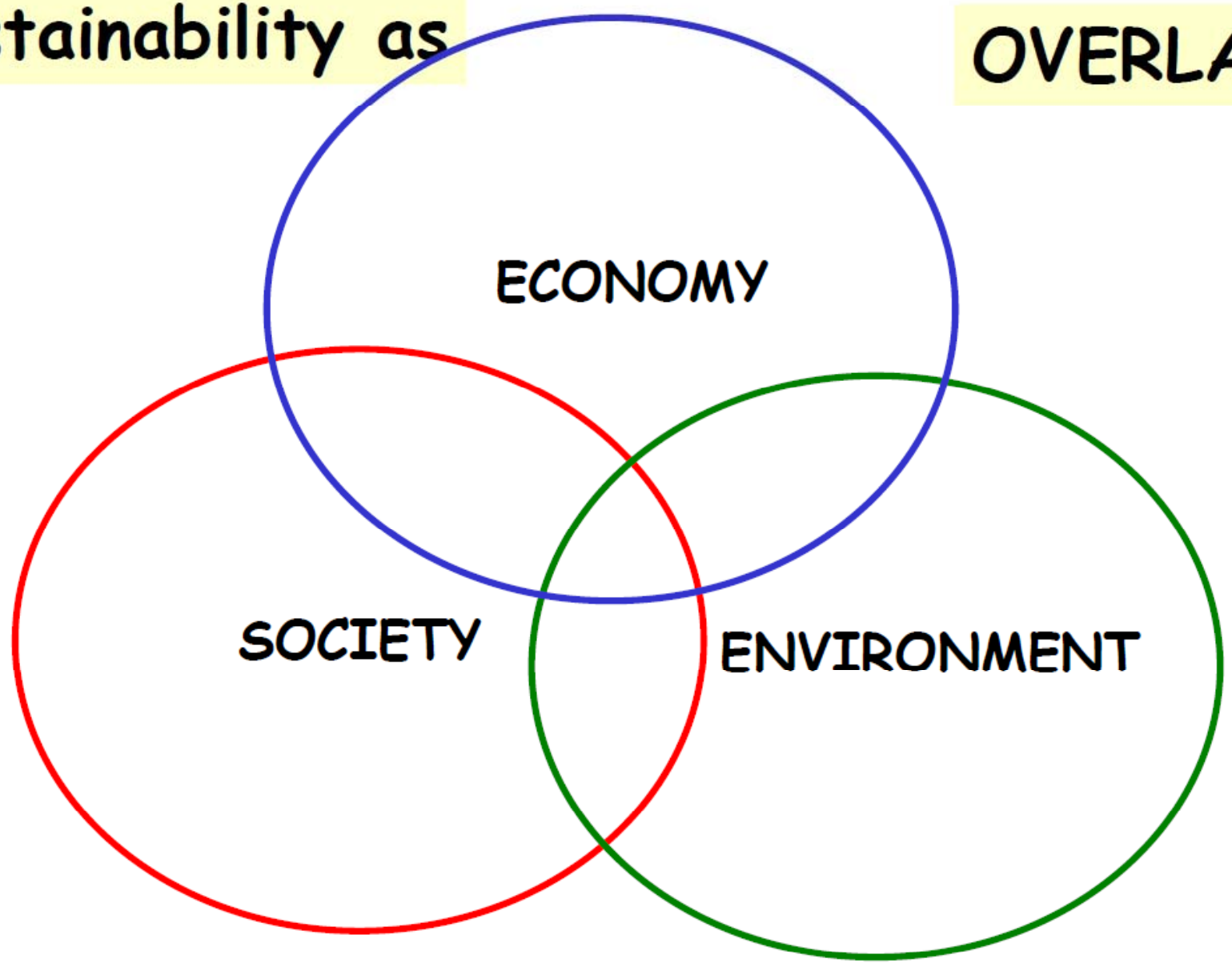
Second generation ~Now: Active nanostructures

Transistors, amplifiers, targeted drugs and chemicals, actuators, adaptive structures, sensors, diagnostic assays, fuel cells, solar cells, High performance nanocomposites, ceramics, metals

Third Generation ~ 2010: 3-D nanosystems and systems of nanosystems

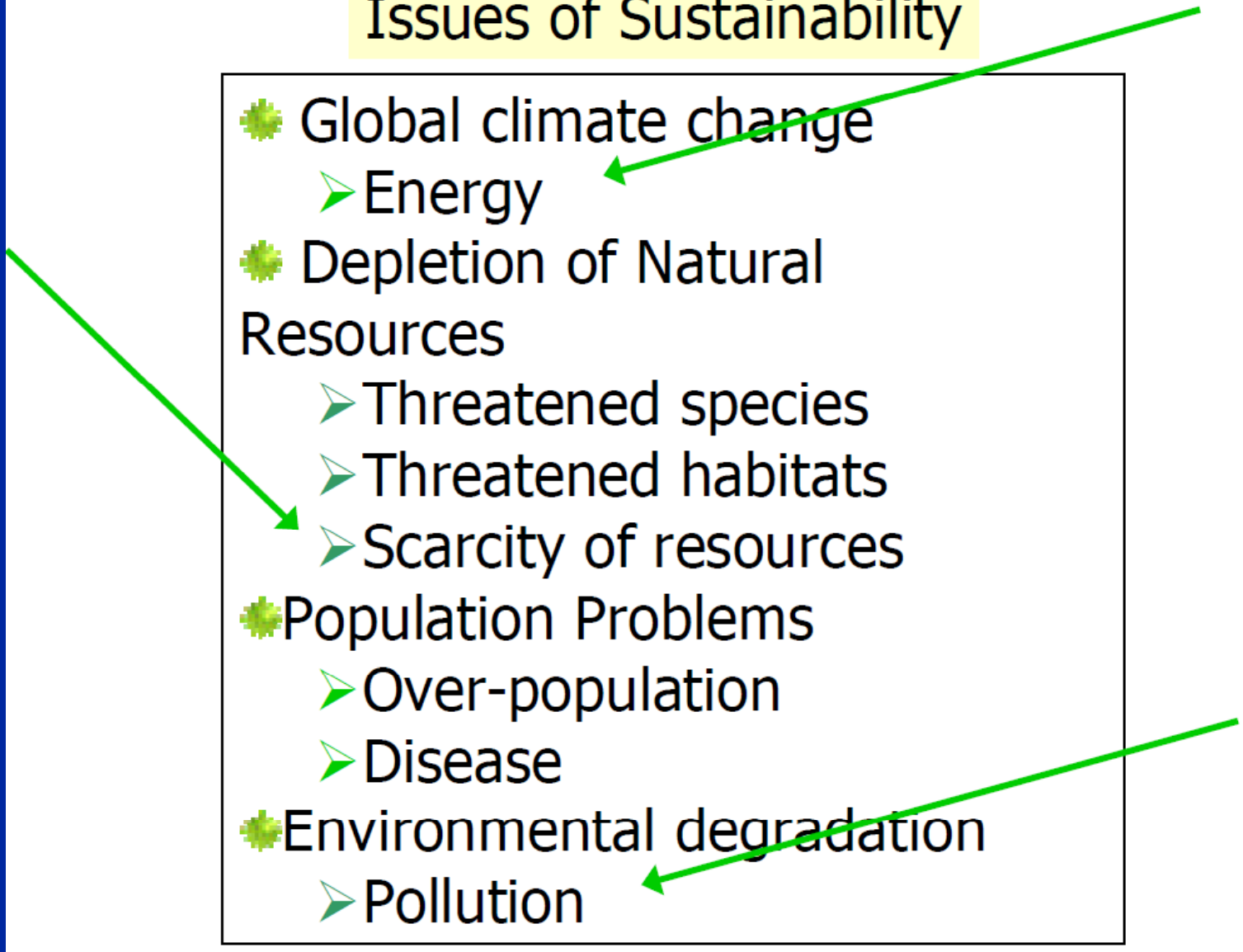
Various assembly techniques, networking at the nanoscale and new architectures, Biomimetic materials, novel therapeutics/targeted drug delivery

Sustainability as OVERLAPS



Issues of Sustainability

- Global climate change
  - Energy
- Depletion of Natural Resources
  - Threatened species
  - Threatened habitats
  - Scarcity of resources
- Population Problems
  - Over-population
  - Disease
- Environmental degradation
  - Pollution



How can nano help?

Global climate change

What can nanotech offer?

Lighter weight materials—less transportation fuel energy use

Efficient electronics—less electrical energy used

More efficient product manufacturing—less production energy

Cleaner burning fuels due to better prefiltration

Natural Resources

What can nanotech offer?

Water filtration systems for drinking water purification and waste removal

Sensors to detect water pollutants, both chemical and biological

Sensors to manage forest ecosystems

Dematerialization—less use of materials as nanotech enables production of smaller products; less waste in building from bottom up

Move to other fuels such as solar, hydrogen
More efficient use of petroleum in materials manufacturing

(Mainly Proactive! Applications)

-Green Manufacturing

two aspects:

--using nanotechnology itself to eliminate the generation of waste products and streams by designing in pollution prevention at the source.

--manufacturing nanomaterials themselves in a benign manner.

Both aspects involve use of environmentally friendly starting materials and solvents, improved catalysts, and significantly reduced energy consumption in the manufacturing process

-Green Energy

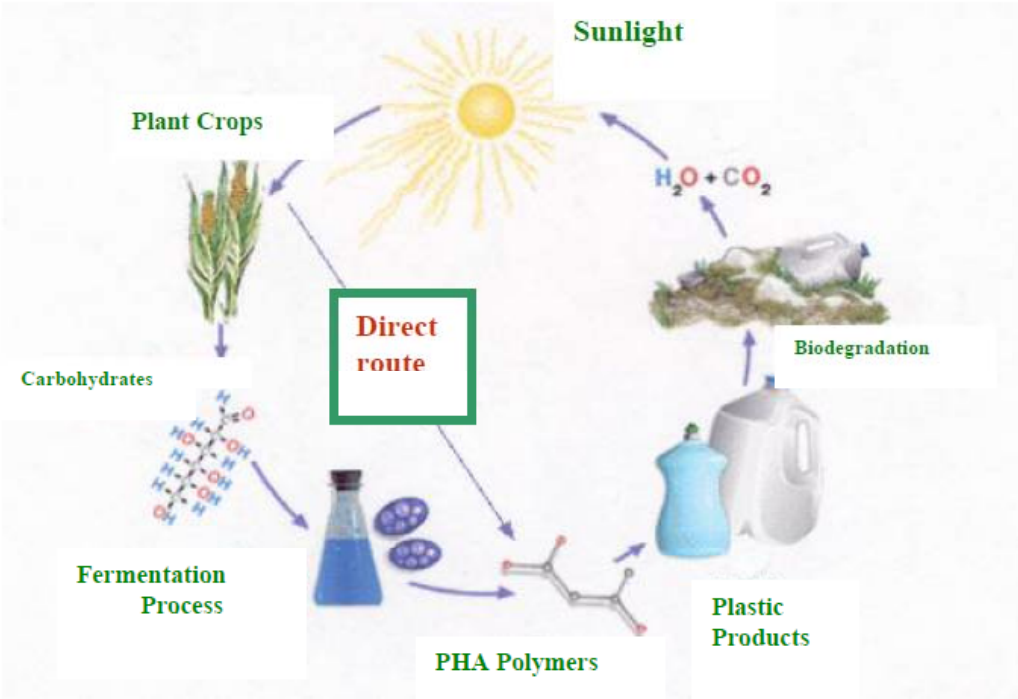
Nano products such as solar and fuel cells could lead to commercially viable alternative clean energy sources

GREEN NANOTECHNOLOGIES for Pollution Prevention

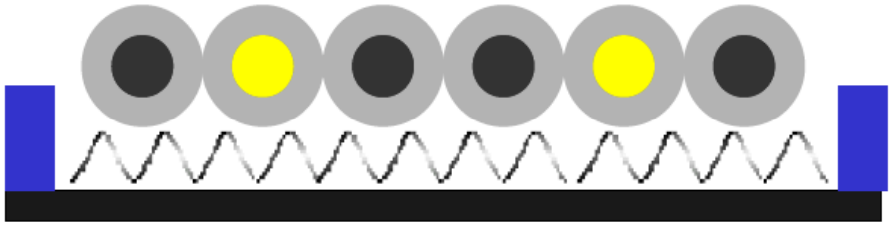
Microwave functionalization of nanotubes

Reduced reaction time
number of reaction steps
Wang, Iqbal, Mitra

Green routes to nanocomposites



Bacterial polyester nanoparticles
Mohanty, Parulekar, Drzal



Biomolecular nanolithography for bottom-up assembly of nanoscale electronic devices Kearns, Hutchison

Nanotechnology is a very powerful new approach that will change our industries and our lives. We have a very small window right now to bring up this technology responsibly and sustainably—to learn from past mistakes and concurrently look at the possibility of harmful implications as we benefit from the applications.

It's an opportunity too important to neglect.

Questions??

That's all. Thanks for your attention

PENSAR DIFERENTE: NANO PIONERO

Richard Feynman
Foto de Archivo del Instituto de Tecnología de California.

Richard P. Feynman

Premio Nobel en Física (1965) por su trabajo fundamental en electrodinámica cuántica, contribución de profundas consecuencias para la física de partículas elementales.

http://www.nano.org.uk/people.htm

"¿Qué pasaría si nosotros pudiéramos organizar los átomos uno por uno de la manera en que nosotros los queremos?"

Richard P. Feynman

En **Caltech, 29 Diciembre, 1959**

There's plenty of room at the bottom

"En el cuarto hay fondo suficiente"

EVOLUCIÓN DE LA NANOTECNOLOGÍA

* La “Nanotecnologia” fue introducida en 1971 por Norio Taniguchi como un término para maquinaria de ultra precisión.

* Invención del Scanning Tunnelling Microscope (STM) por Binnig and Rohrer en 1981.

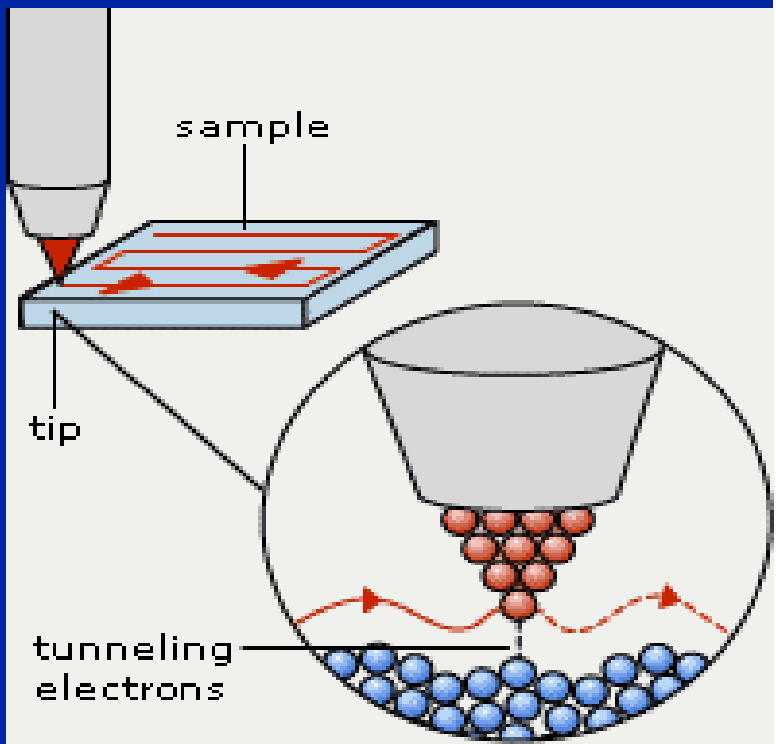
* Investigadores de IBM hacen el famoso “escrito” usando Átomos de Xenon.

*Los fluerenos (C60) fueron descubiertos en 1986 por Curl, Kroto and Smalley

Scanning Tunnelling Microscopy

- **Binnig and Rohrer – 1982**

- **Piezoelectric scanner positions atomically sharp tip over sample.**



STM'86

Scanning Tunneling Microscopy'86

Santiago de Compostela (Spain)

July 14-18 1986


SCANNING
TUNNELING
MICROSCOPY'86
STM'86
Santiago
de Compostela
July,14-18,1986

HERRAMIENTAS PARA VER Y MANIPULAR LOS INGENIOS NANOTECNOLÓGICOS

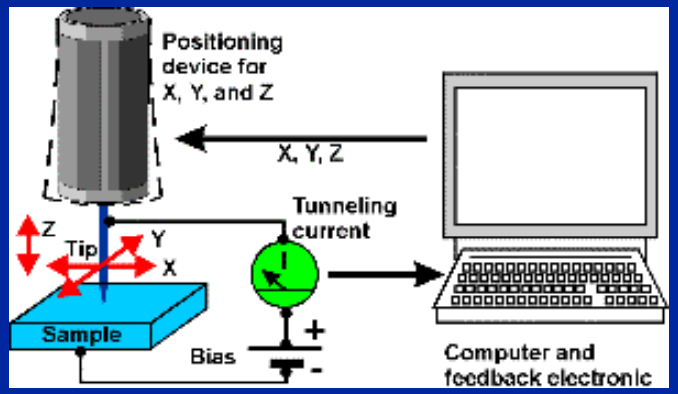


Ilustración esquemática de un Microscópio de Barrido Tunel (STM)

Microscópio de Barrido Tunel (STM) es una técnica microscópica que permite la investigación de superficies conductoras de electricidad a nanoescala

Microscópio de Fuerza Atomica (AFM), es particularmente útil para ver muestras biológicas.

Los STM y los AFM "pueden mover" átomos, y son dispositivos no mayores que un "raton" que se enchufa a un puerto USB de un PC

Los STM y los AFM son una familia de instrumentos usados para medir propiedades de superficies.

OPORTUNIDAD PARA EL DESARROLLO

En la historia, cada vez que se produjeron cambios drásticos de paradigmas, los modos antiguos de producción se volvieron obsoletos.

La Nanotecnología puede constituir una gran oportunidad de los Países en vías de Desarrollo para encontrar sus nichos productivos.