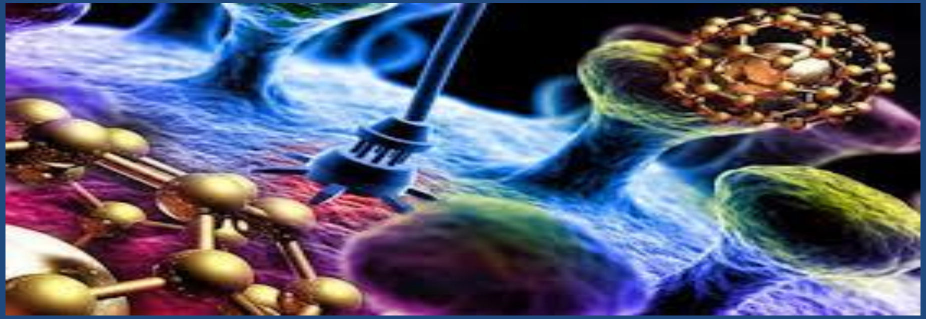
Standardisation for Nanotechnology



Stephen Thomas ChOHSP, ChFSIA

SISA General Meeting, 17 February 2017

What is Nanotechnology?

The science of **manipulating atoms and molecules** to fabricate materials, devices and systems. Unlike current production methods, in which existing parts and components are combined, nanotechnology takes atoms and precisely assembles them to produce items with **desirable characteristics**….

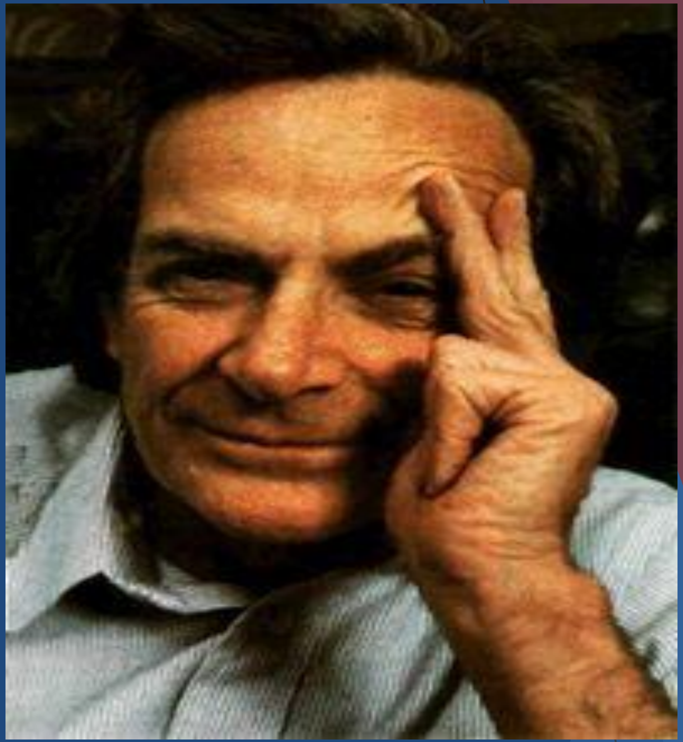
History

- The first ever concept was presented in 1959 by the famous professor of physics Dr. Richard P.Feynman.

- Invention of the scanning tunneling microscope in 1981 and the discovery of fullerene(C60) in 1985 lead to the emergence

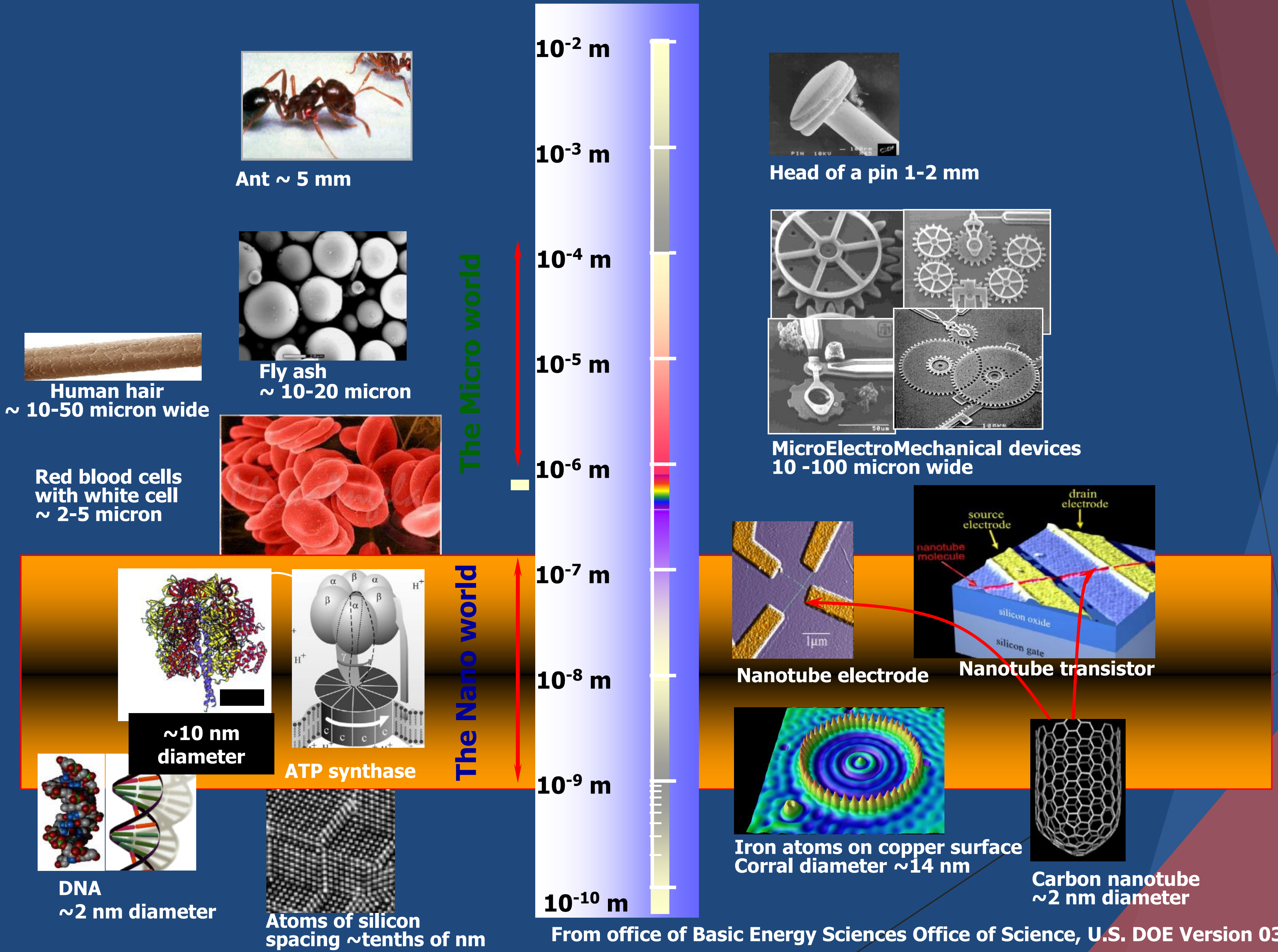
  of **nanotechnology.**

- The term "Nano-technology" had been coined by Norio Taniguchi in 1974



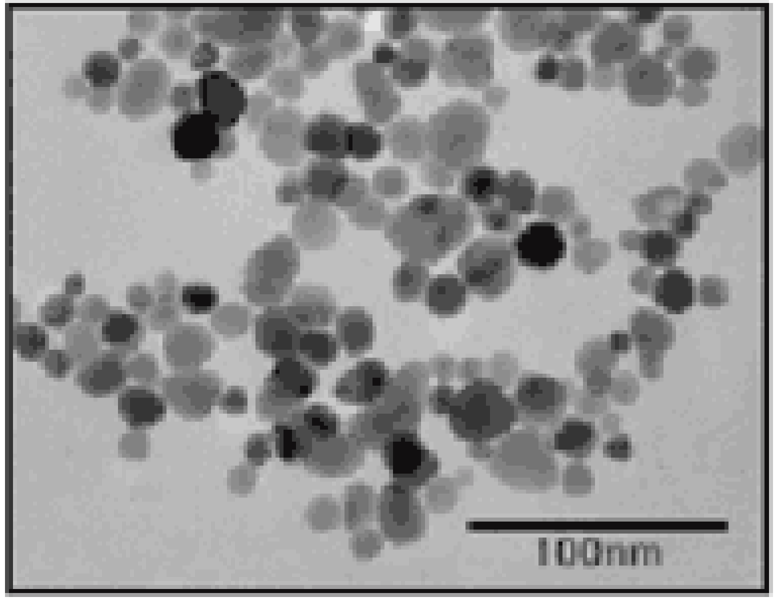
THERE'S PLENTY OF ROOM AT THE BOTTOM

How small is nano?

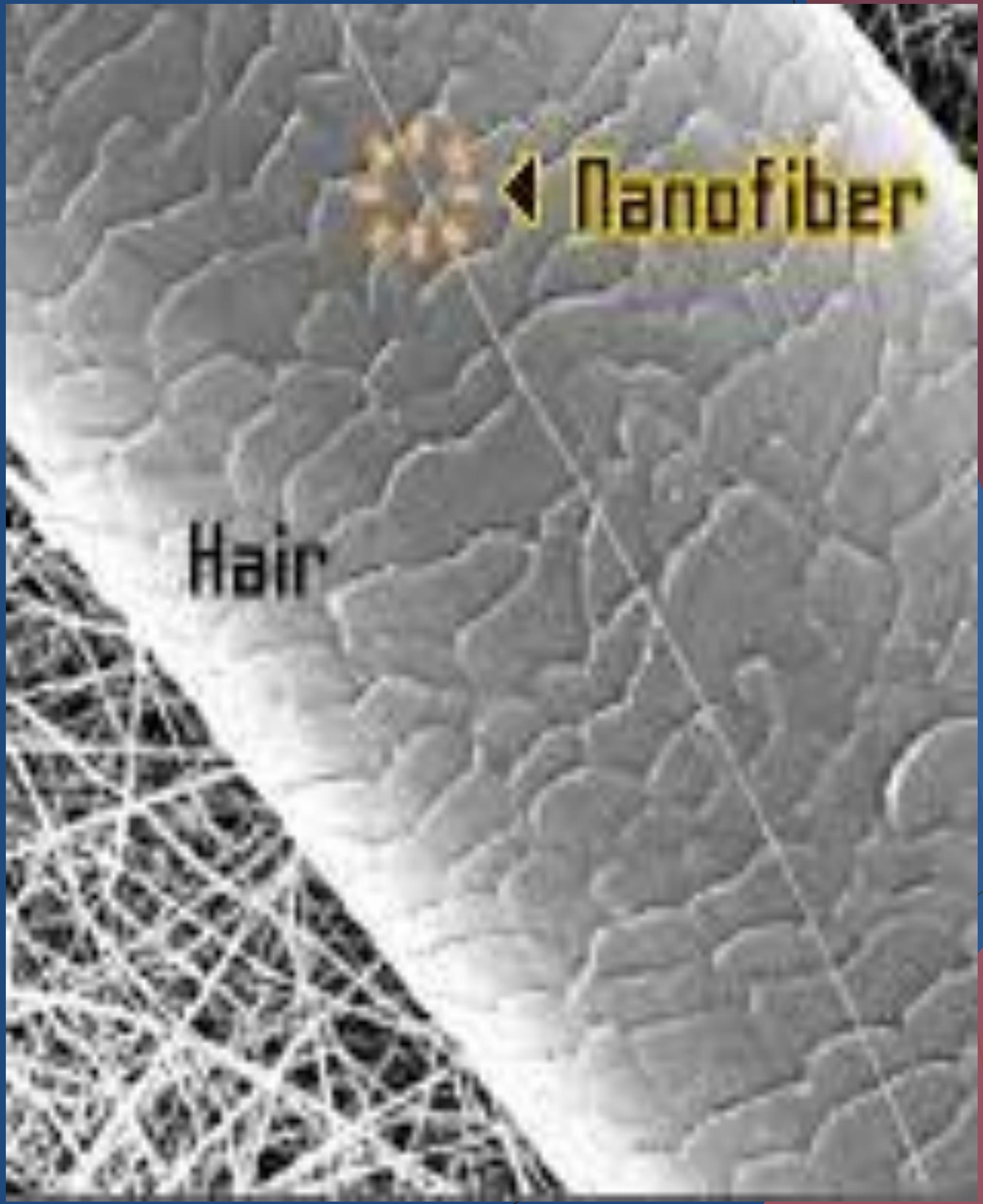


From office of Basic Energy Sciences Office of Science, U.S. DOE Version 03-05-02

How small is nano-small?



TEM Particle Size = 25nm

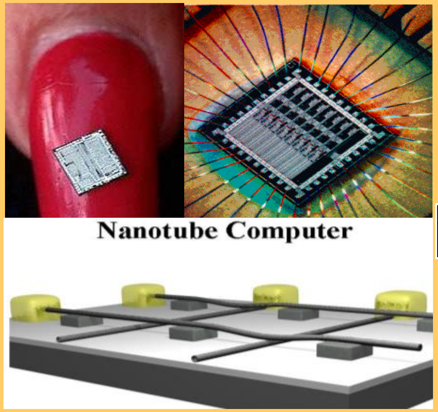


Nano is an enabling technology for the future

PAST/NOW

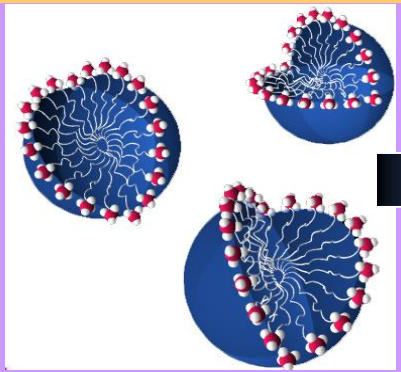
Nanotechnology

FUTURE

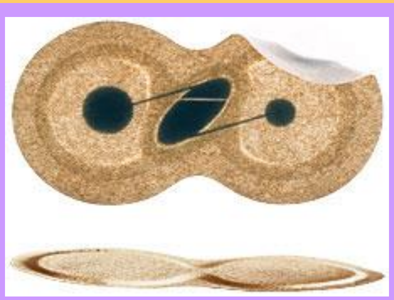


Nanochips

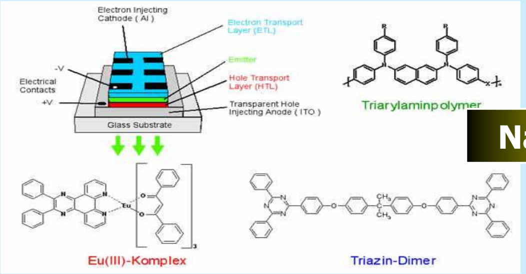
Handheld computer, watchphone



Nanocapsules



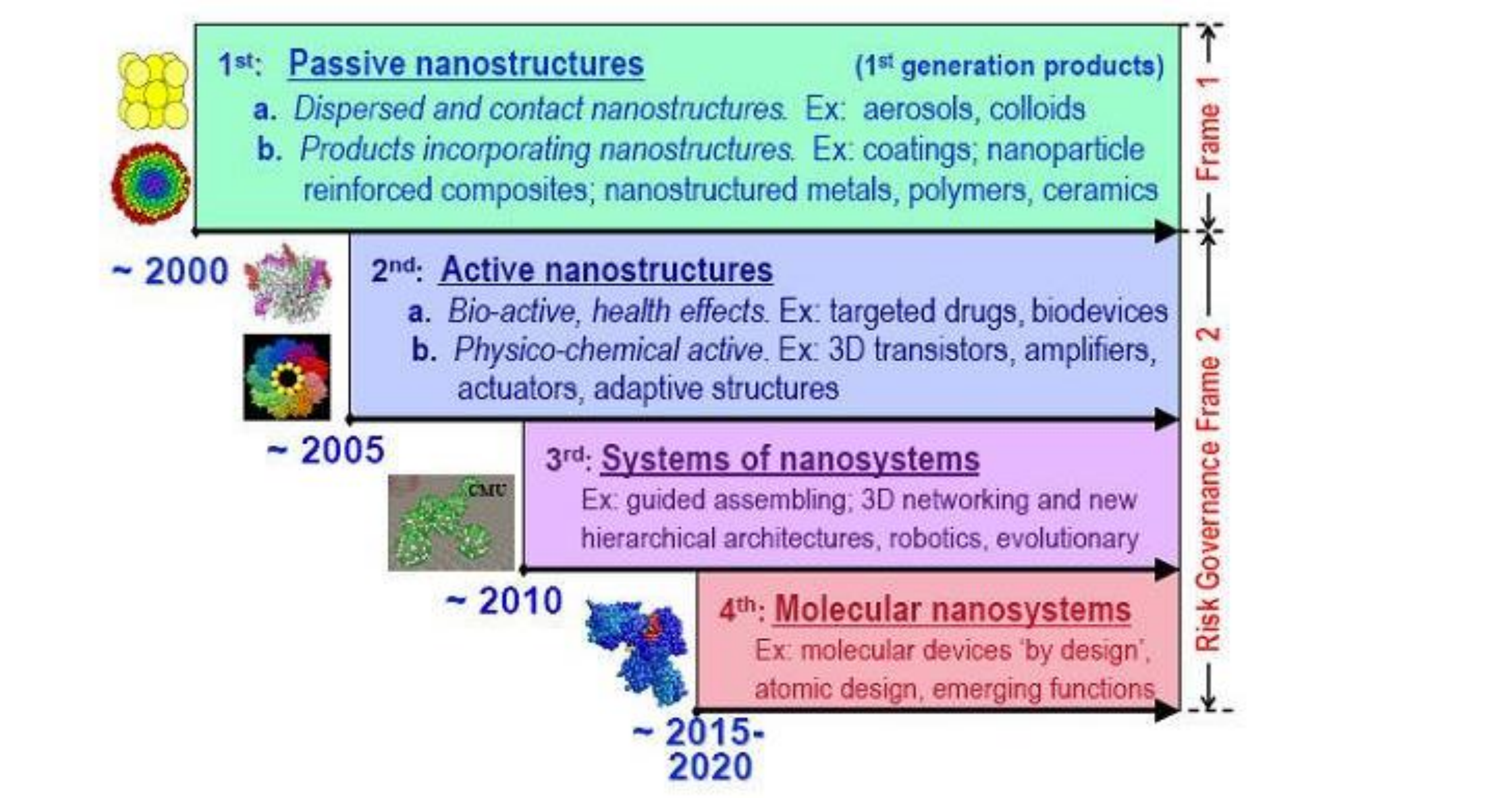
Electronic transdermal drug delivery patch



Nanofilms

Flexible thin screen

Timeline



1st: Passive nanostructures
(1st generation products)
a. Dispersed and contact nanostructures. Ex: aerosols, colloids
b. Products incorporating nanostructures. Ex: coatings; nanoparticle reinforced composites; nanostructured metals, polymers, ceramics
~ 2000
2nd: Active nanostructures
a. Bio-active, health effects. Ex: targeted drugs, biodevices
b. Physico-chemical active. Ex: 3D transistors, amplifiers, actuators, adaptive structures
~ 2005
3rd: Systems of nanosystems
Ex: guided assembling; 3D networking and new hierarchical architectures, robotics, evolutionary
CMU
~ 2010
4th: Molecular nanosystems
Ex: molecular devices 'by design', atomic design, emerging functions
~ 2015-2020
Frame 1
Risk Governance Frame 2

Possibilities for the future

- Nanotechnology may make it possible to manufacture lighter, stronger, and programmable materials that
  - require less energy to produce than conventional material
  - and that promise greater fuel efficiency in land transportation, ships, aircraft, and space vehicles.

- The future of nanotechnology could very well include the use of nanorobotics.

- These nanorobots have the potential to take on human tasks as well as tasks that humans could never complete. The rebuilding of the depleted ozone layer could potentially be able to be performed.

Pitfalls of nanotechnology

- Nano-particles can get into the body through the skin, lungs and digestive system, thus creating free radicals that can cause cell damage.
- Once nano-particles are in the bloodstream, they will be able to cross the blood-brain barrier.
- The most dangerous Nano-application use for military purposes is the **Nano-bomb** that contain engineered self multiplying deadly viruses that can continue to wipe out a community, country or even a civilization.
- Nanobots because of their replicating behavior can be big threat for GRAY GOO.

Inherent Risks in Nanotechnological Fields

Materials/ Powders	Nanobio / NanoMedicine	Devices	Instrumentation	Nanofactory/ Replication
- Novel Materials - Nano Particles - Surfaces	- Biomaterials - Life Sciences	- Optical Devices - Light Sources - Sensors - Energy Storage - Photovoltaics	- Tips and Probes - Data Storage	- Machining - Self Assembly
Environment Risks	Environment Risks	Environment Risks	Environment Risks	Environment Risks
Toxicity	Toxicity	Toxicity	Toxicity	Toxicity
Societal Impacts	Societal Impacts	Societal Impacts	Societal Impacts	Societal Impacts
Economic uncertainty	Economic uncertainty	Economic uncertainty	Economic uncertainty	Economic uncertainty

No or little risks	Medium risks	High risks

What Standards Do

- Provide governments with a technical base for health, safety and environmental legislation, and conformity assessment
- Share technological advances and good management practice
- Disseminate innovation
- Safeguard consumers, and users in general, of products and services
- Make life simpler by providing solutions to common problems

ISO TC 229 Nanotechnologies

SCOPE:

Standardization in the field of nanotechnologies that includes either or both of the following:

- Understanding and control of matter and processes at the nanoscale, typically, but not exclusively, below 100 nanometres in one or more dimensions where the onset of size-dependent phenomena usually enables novel applications,

- Utilizing the properties of nanoscale materials that differ from the properties of individual atoms, molecules, and bulk matter, to create improved materials, devices, and systems that exploit these new properties.

SCOPE:

The development of science-based standards in the areas of health, safety, and environmental aspects of nanotechnologies.

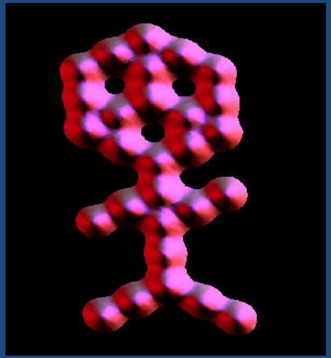
OBJECTIVE:

The development of high quality health, safety and environmental standards that will improve occupational safety, consumer protection and environmental protection by promoting good practice in the production, use and disposal of nano-materials, nanotechnology products and nanotechnology-enabled systems.

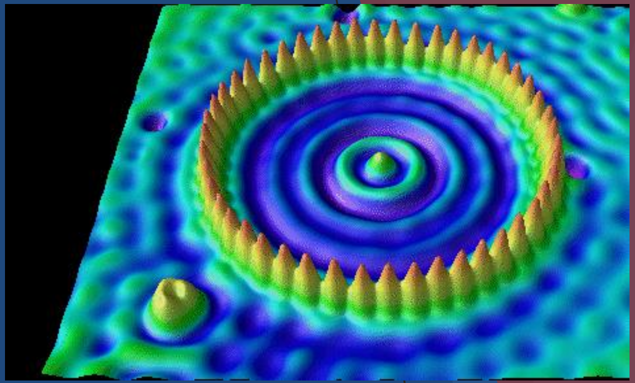
ISO/TC 229-WG 3 : Focus & Roadmap

Current Projects

- PG 1Rev – Health and safety practices in occupational settings relevant to nanotechnologies
- PG 12 Compilation and description of sample preparation and dosing methods for engineered and manufactured nanomaterials
- PG 15 General framework for the development of occupational exposure limits for nano-objects and their aggregates and agglomerates
- PG 16 - Electron spin resonance (ESR) as a method for detecting reactive oxygen species (ROS) generated by metal oxide nanomaterials,
- PG 17 - Modified MTS Assay for measuring the effect of nanoparticles on cell viability
- PG 18 - DCFH-DA Assay for evaluating nanoparticle induced intracellular ROS production, PG 19 - The use and application of acellular in *vitro* tests and methodologies to assess nanomaterial biodurability
- PG 20 - Characteristics of working suspensions of nanoobjects for *in vitro* assays to evaluate inherent nano-object toxicity
- PG 21 - Aerosol generation for NOAA (nano-objects and their aggregates and agglomerates) air exposure studies



Thank you



Questions ?