

NANOTECHNOLOGY

& NANO-MATERIALS

INTRODUCTION



- Nanotechnology is the creation of functional materials, devices, and systems through control of matter on the nanometer (1 to 100+ nm) length scale.
- Nanotechnology-anything smaller than microtechnology such as nano powders.
- A **nanometer** is one billionth of a meter smaller than a micron, (e.g., a DNA molecule is about 2.5 nm long while a sodium atom is about 0.2 nm).
- **Bottom up approaches**-Designing and synthesizing custom-made molecules that have the ability to self-assemble or self-organize into higher order mesoscale and macroscale structures

What is Nanotechnology



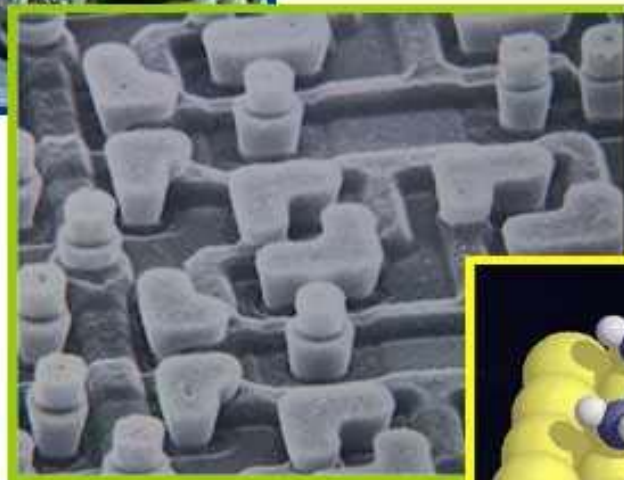
- “**Nanotechnology** is the understanding and control of matter at dimensions of roughly 1 to 100 nanometers, where unique phenomena enable novel applications. Encompassing nanoscale science, engineering and technology, nanotechnology involves imaging, measuring, modeling, and manipulating matter at this length scale.”

Macro – Micro - Nano



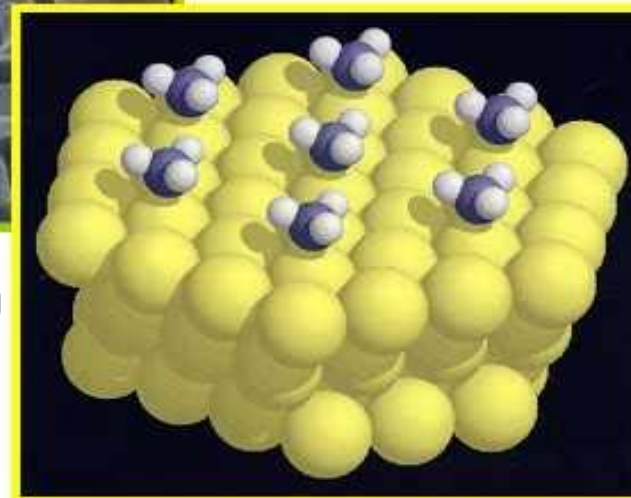
**Macro or Conventional
Machines**

(m - mm)



Micromachines

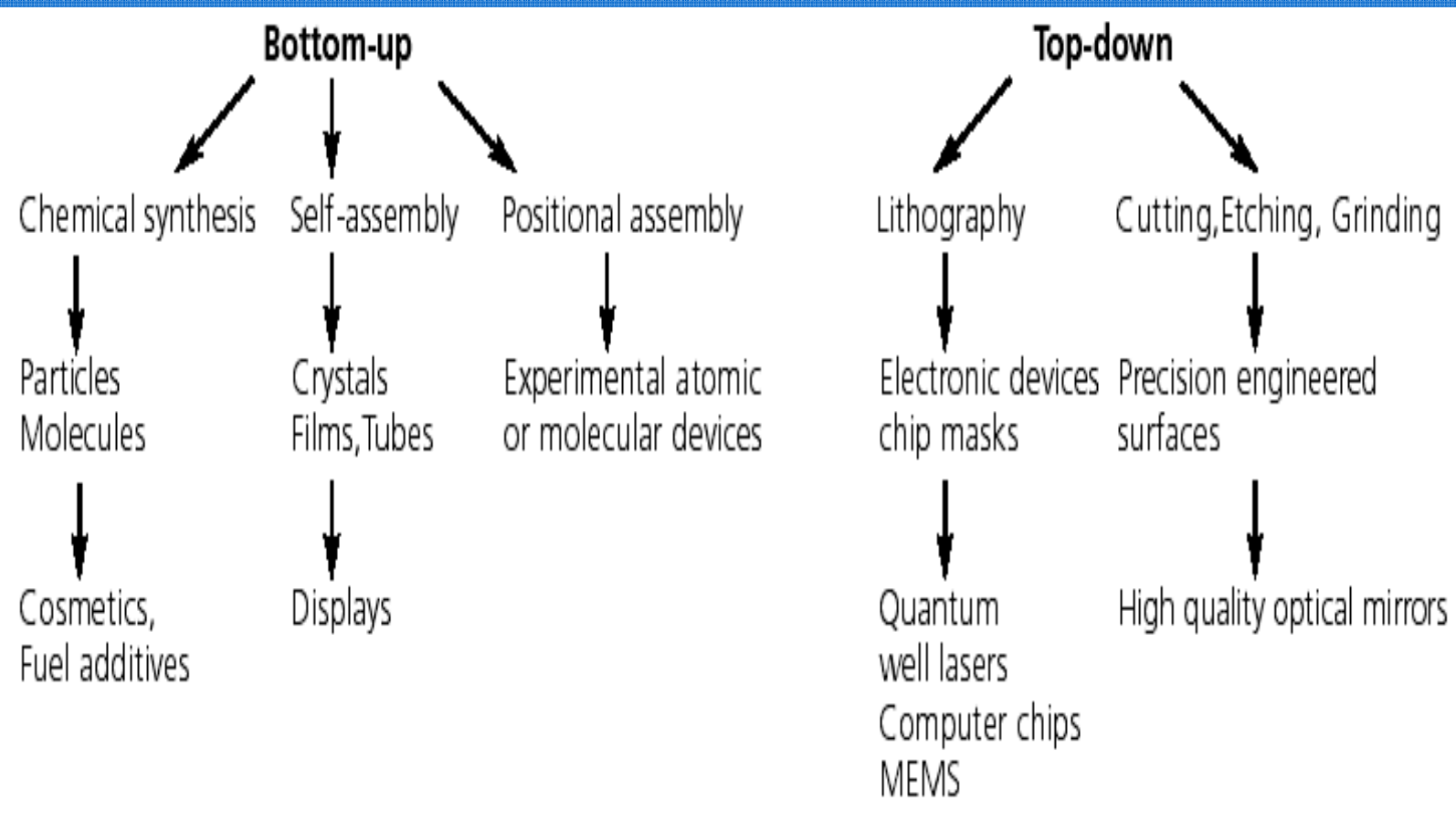
(0.1 mm - 0.1 μ m)



Nanosystems

(100- 1 nm)

Principle of Nanotechnology

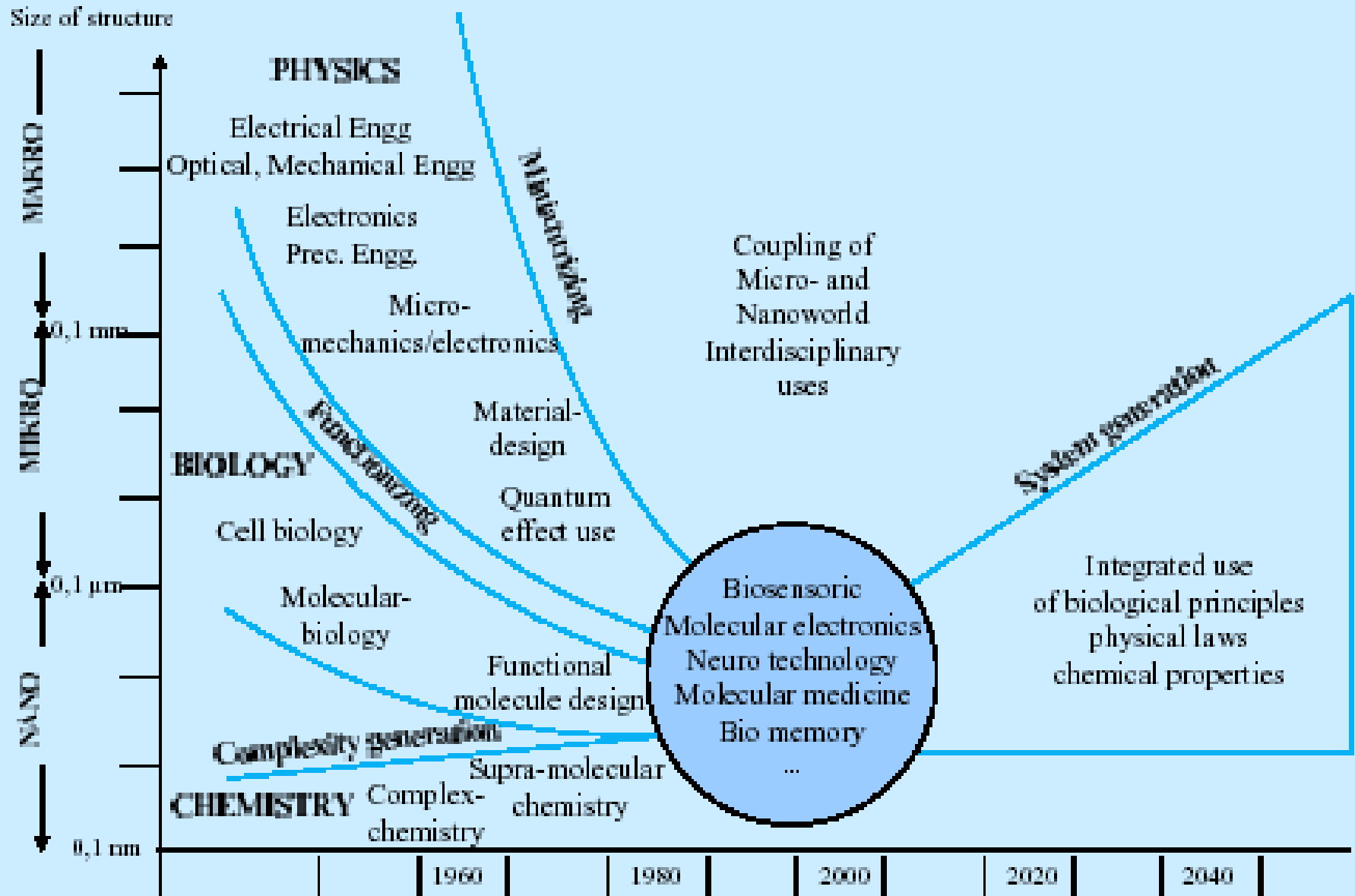


Products are manufactured one atomic particle at a time.

Top-down:

Every product begins with a bulk material process and is subsequently refined down.

Development of nanotechnology



Nanoparticles property

Electrical properties

- Conductivity
- Static dissipation (electro kinetic phenomena, lightning strikes, high voltage wires, etc.)
- Electromagnetic compatibility
- Enhanced thermal conductivity

Mechanical properties

- Reduce weight - Lighter material for automotive or airplanes applications and
- reduction of energy consumption
- Corrosion resistance to acids and high temperature
- Nanocomposites lower coefficient of thermal expansion
- Scratch resistance Strength

Applications

- Automobile engine application
- Cutting tool nanocoatings for dry machining
- Nanolayer lubricants for nanomachine
- Nanocoating in the field of electroplating
- Nanopowder used in advanced energy application

Applications

- Anti-slip surfacing for heavily trafficked pedestrian areas (aviation, transportation, marine, sports, industry)
- Good handling and adhesive properties



Scratch-proof resistant coatings

- Scratch-proof resistant coatings on car windscreens, mobile phones, helmets etc.
- Multifunctional paints
- Functional clothing
- Sensor technology packaging
- Light-weight materials



Nanostructured surfaces and coatings have wide commercial applications

Nano

Thin films, paints

- Self-cleaning
- Scratch-resistance
- Protective
 - UV-light, corrosion
- Water and dirt resistant
- Energy efficient
- Conductive

Mercedes:
scratch-resistant
paint



TiO₂ coating:
breaks organic dirt
hydrophilic (rinses)



Tikkurila Titan:
UV protection

Packages

- Anti-bacterial
- Barrier properties
 - Moisture behavior,
gas permeability, UV-shield
- Sensor properties



Indicator labels
and sensors

water, dirt,
odour resistant



Industrial protective coatings

- fracture strength, hardness, density,
wear and friction resistance

Nanomaterials is a field which takes a materials science-based approach to nanotechnology. It studies materials with morphological features on the nanoscale, and especially those which have special properties stemming from their nanoscale dimensions