NANOTECHNOLOGY – Part B
(The Quiet Revolution Changing the World)

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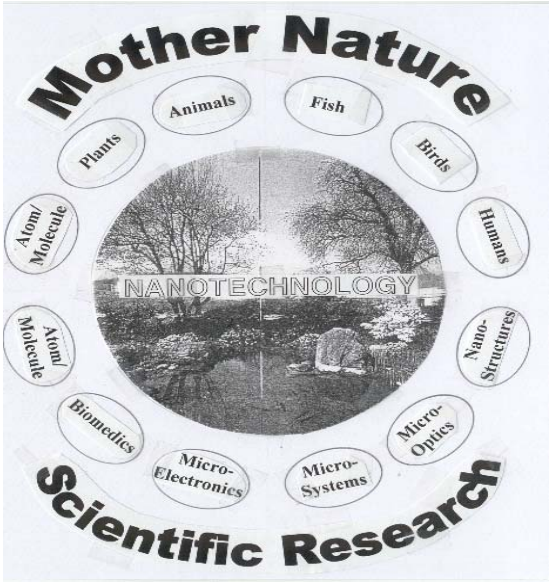
Nanotechnology is often referred to as general-purpose technology since in its most advanced form it will have an effect on almost all industries and areas of society. It will offer better built, longer-lasting, cleaner, safer, and smarter products for the home, communications, medicine, transportation, agriculture, and industry. The world is on the brink of technological revolution capable of bringing wealth, health and education without pollution to all on earth.



Imagine a medical device that can travel through a human body to find and destroy cancer cells before they have a chance to spread throughout the body. There would be no need for cutting open a patient to get at affected cells. Or a small box, no larger than a sugar cube, that can hold the entire contents of as large encyclopedia. Nature is an example of the many possibilities of using a wide range of processes, procedures and sequences in a minimum of space. Nanotechnology and nanoscience got started in the early 1980s with two major developments; the birth of cluster science and the invention of the scanning tunneling microscope.

Manufactured Products

- **Metal Rubber™**, a novel material that conducts electricity like a metal but also stretches like rubber up to 250% of its original length. This material can be used for artificial muscles, flexible electronic circuits, antennae or mirrors and smart skin for aircraft.
- Custom-designed thin-film materials that exhibit enhanced optical, electrical, magnetic, thermal and mechanical properties. These may find use in window coatings, fuel cells, space structures, biomedical and electronic devices, and optical networking equipment.
- The self-cleaning toilet, available commercially, where the bowl is sealed with a super-smooth glaze that has microscopic holes under 30 nanometres. Because these holes are

smaller than bacteria or mould particles, there's not enough room for debris to get lodged in the porous surface. Flushing is basically all the work that has to be done.

Nanotubes

Researchers in nanotechnology have developed the carbon nanotube which is as tough as nails-much tougher. It is a very thin sheet of graphite that is formed into a tube consisting of tiny straw-like cylinders, which can be as small as half a nanometre wide, are up to 100 times stronger than steel and six times lighter. They are among the world's best conductors of heat and electricity carrying 1,000 times more electrical current than copper wire.

- They are being considered as additives to construction materials because of their strength.
- Aircraft company are thinking that nanotubes may be the source of future improvements for high-performance aircraft.
- Futuristic yarns could be woven into "smart" clothing that stores **electricity,** is potentially bulletproof and incorporates sensors capable of **adjusting** the temperature of the garment.
- The fibres could also be made into cables for suspension bridges much longer than any in existence today.
- Research scientists are excited about the possibility of making super-strong, super-light sheets that would make ideal solar sails. With a solar sail it is possible to use the pressure of the sun's light to move a craft through space the same way wind powers a sailboat.

Manufacturing in the Future

A new, more powerful industrial revolution is on the horizon that is capable of bringing wealth, health, and education, without pollution, to every person on the planet.

- Automatic factories (factory-on-a-chip) producing consumer goods.
- New products with extraordinary qualities undreamed of today.
- No depletion of natural resources, no longer will forests need to be cut or smoke spewed into the air.
- Pollution-free manufacturing with lower costs and improved quality.
- Fuel cells and energy management systems.
- Small optoelectronic devices - cheaper, have more functions, and use less power
- Metal rubber - bends and stretches like rubber and conducts electricity.

Solar Energy

In nanoland, tiny differences in size can add up to huge differences in function and matter is "tunable" at the nanoscale.

- Change the length of a guitar string and it changes the sound; change the size of semiconductors called quantum dots, and the colour changes. A three-nanometre dot that glows blue, a four-nanometre dot that glows red and a five-nanometre dot that emits infrared rays or heat.
- Tuning matter is more than a pretty light show, it may be the key to making a cheap, flexible solar panel - one that captures the sun's energy efficiently and converts it to electricity. It is predicted that in 20 years it will be as cheap and convenient to harness the sun's power.
- Fuel cells could become the source of energy for light-weight portable power packs.