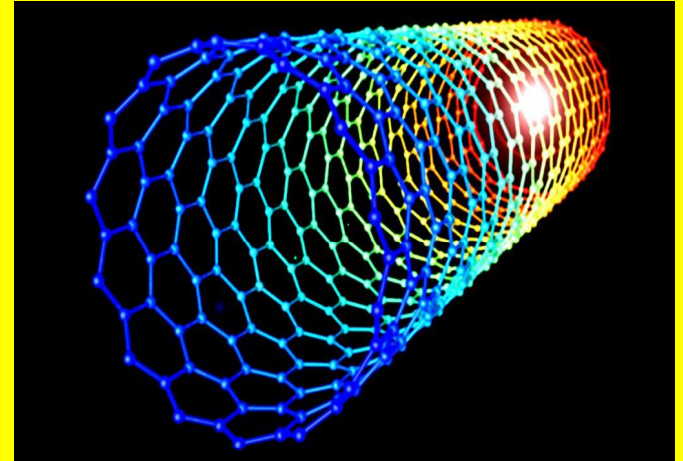
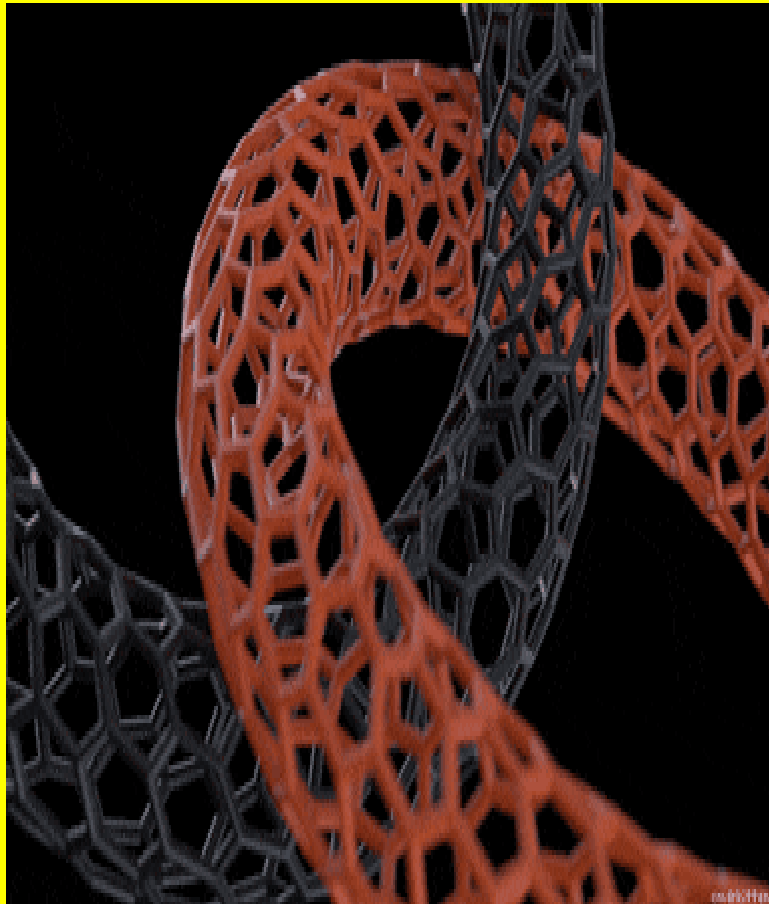


**ALL FOR THE
HIGHEST GLORY
OF GOD**

APPLICATIONS, ADVANCES AND ISSUES OF NANOMATERIALS



**Dr. B.Helina Fredy,
Assistant Professor of Physics,
St.Xavier's College,
Palayamkottai – 2.**

**CARBON
NANOTUBES**

GRAPHENE

**NANO-
COMPOSITES**

NANO FIBRES

**NANO-
PARTICLES**

NANOWIRES

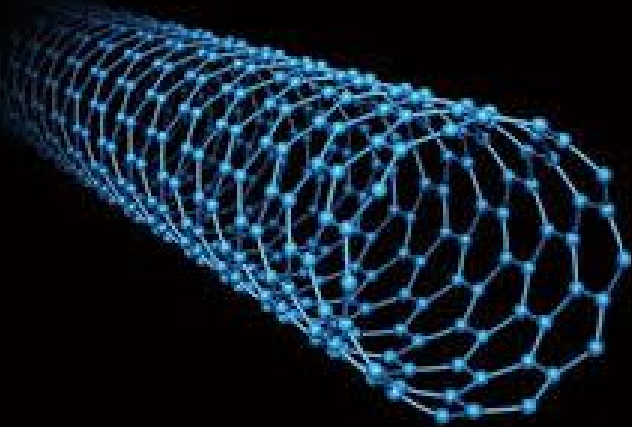
NANORODS

APPLICATIONS

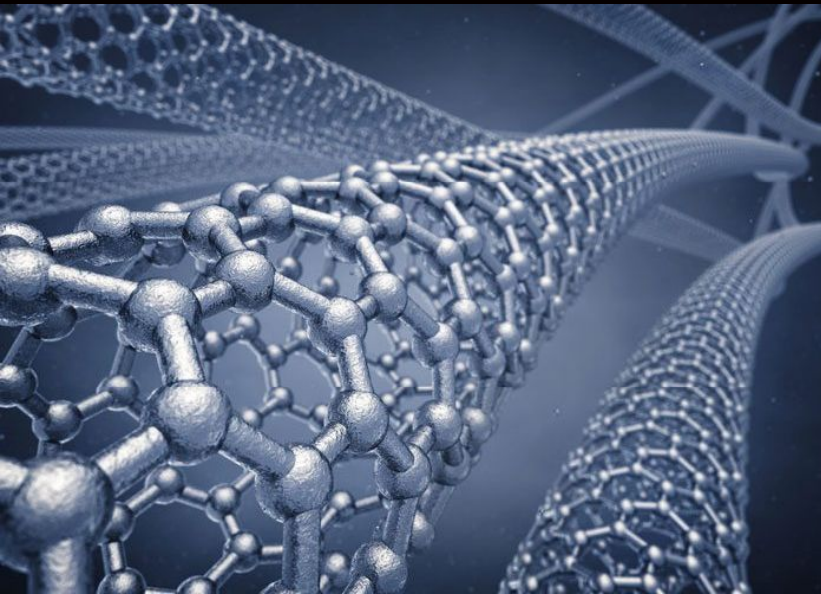
NANORIBBONS

FULLERENE

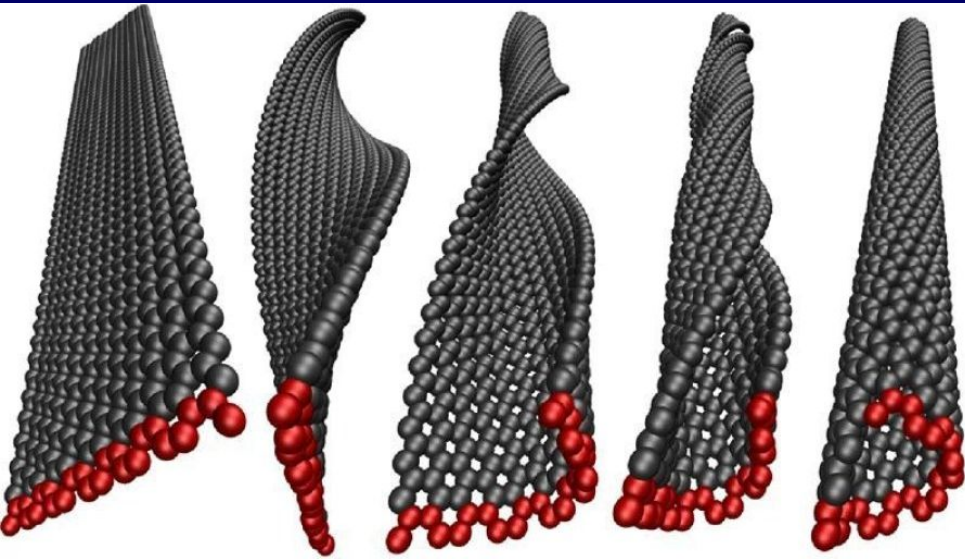
CARBON NANOTUBES



- **Bacteria sensors (antibodies)**
- **Making a composite with nanotube; electric voltage – bends the wings of morphing aircraft.**
- **Nanotubes to trap oil spills**
- **Includes smaller transistors**
- **Silicon coated nanotubes to increase the capacity of Li-ion batteries (10 times)**

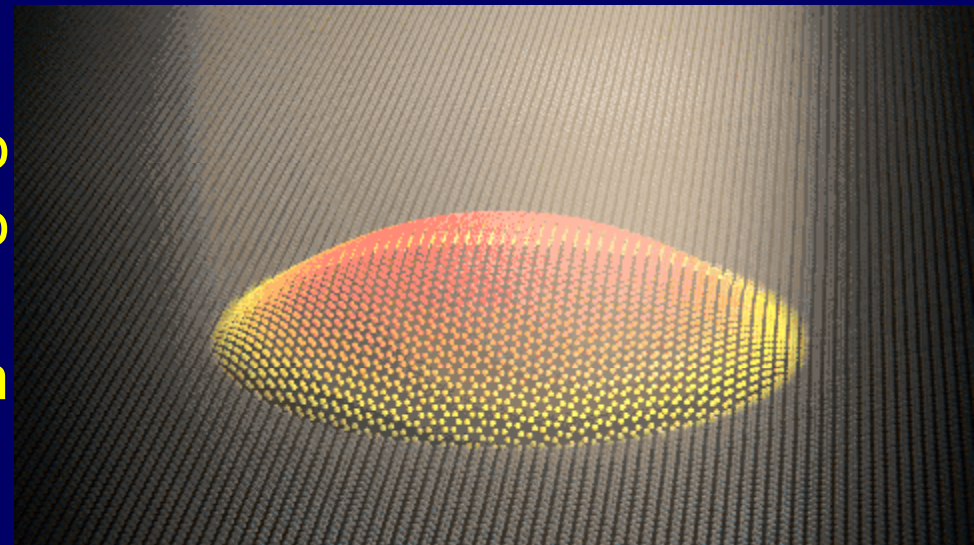


GRAPHENE

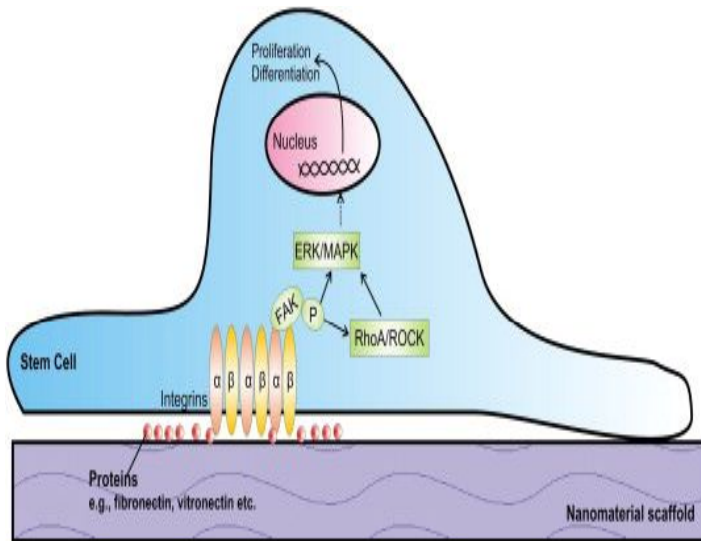


- Graphene sheets as electrodes in ultra-capacitors – as batteries have large storage capacity – in minutes.
- Attaching strands of DNA to graphene to form sensors

- Strands of DNA attached to graphene – sensor – to diagnose the disease.
- Replaces indium in flat screen TVs.

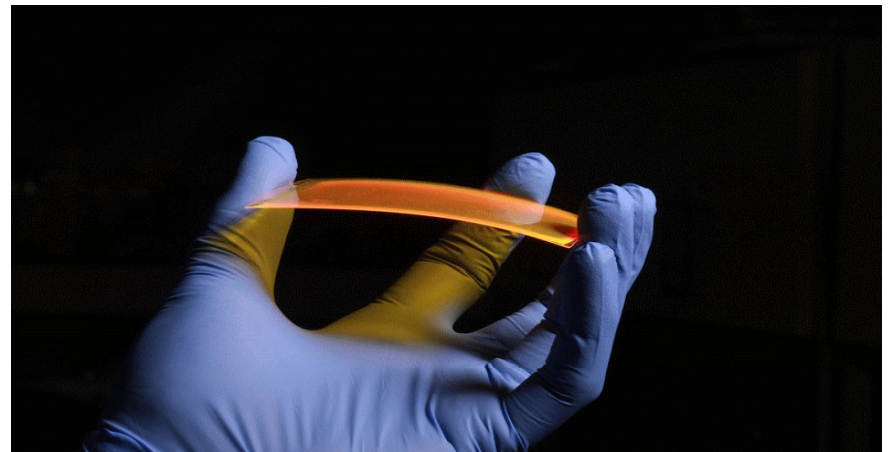


NANOCOMPOSITES

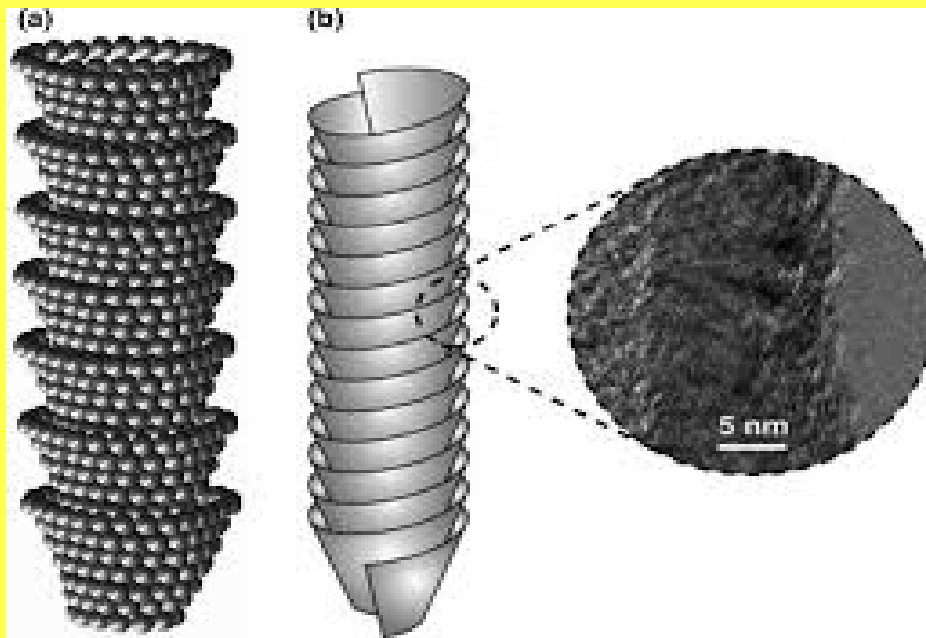
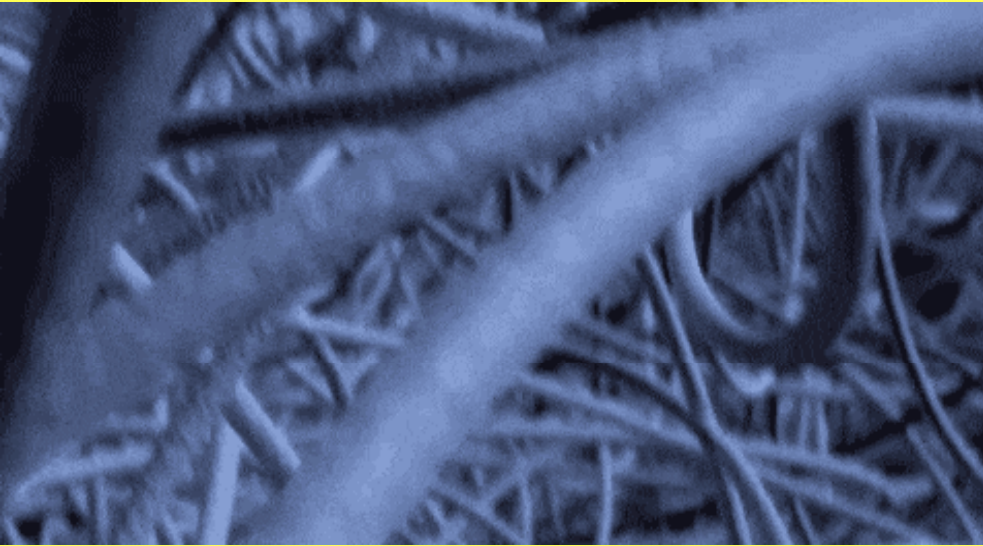


- Form a nano scaffold which speeds up replacement of broken bones.
- Graphene-epoxy (sets hard) nano composite with high strength to weight ratios.

• From Cellulose nano composite is used to make a flexible battery.

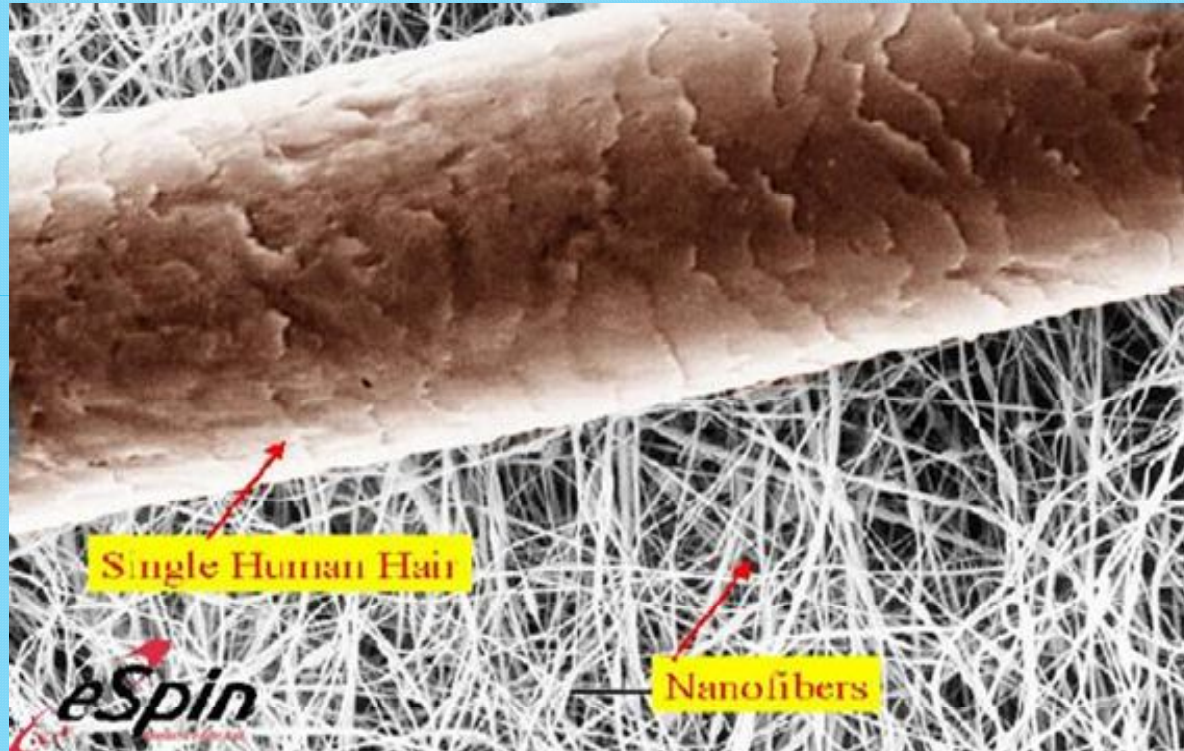


NANOFIBRES



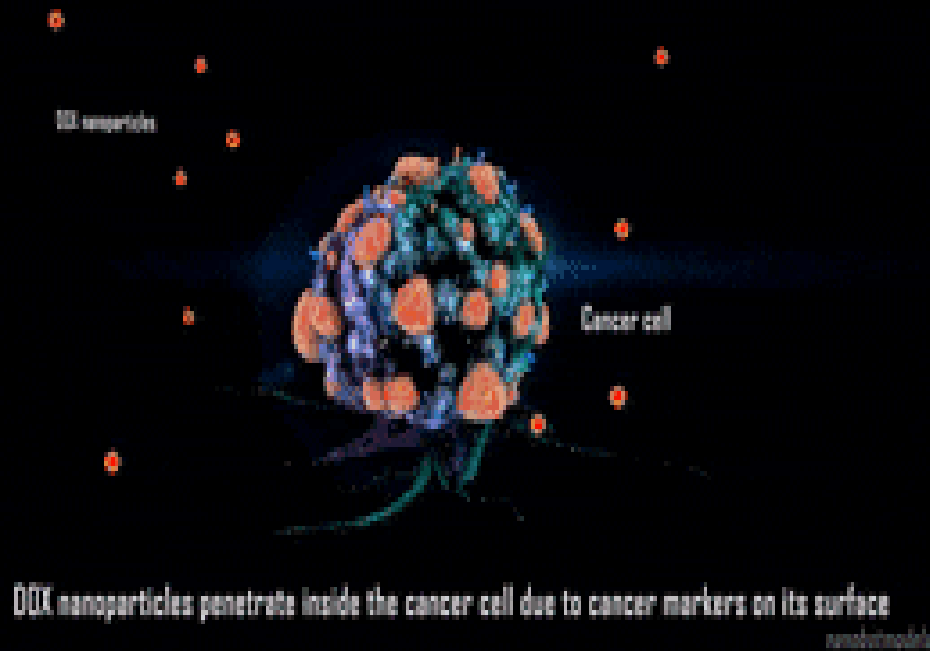
- Nanofibres - can stimulate the production of cartilage in damaged joints.
- To deliver therapeutic drugs through - embedded with needle-like CNF's used as balloons – insert to diseased cells.
- Piezoelectric nanofibres - woven into clothing for producing electricity.
- Carbon nanofibres - improve flame retardant by coating the foam used in furniture.

Compared to Human Hair



A Human Hair is about $100,000\mu\text{m}$ wide

NANOPARTICLES

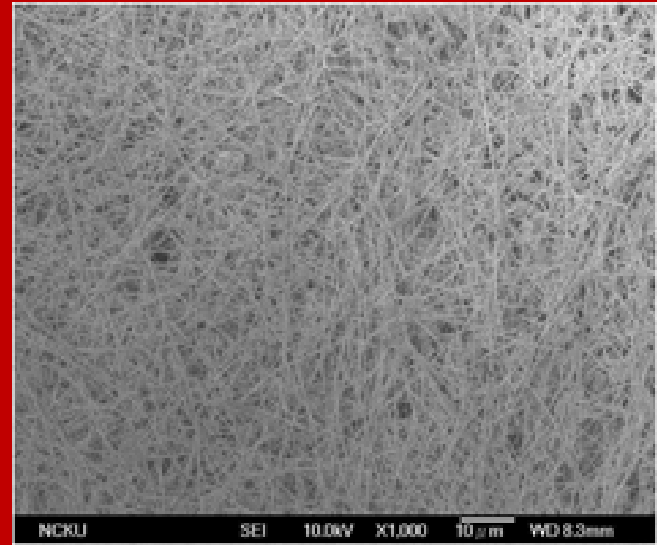


Deliver
chemotherapy drugs
directly to cancer
tumors.

To damaged arteries -
To fight cardio vascular
disease.

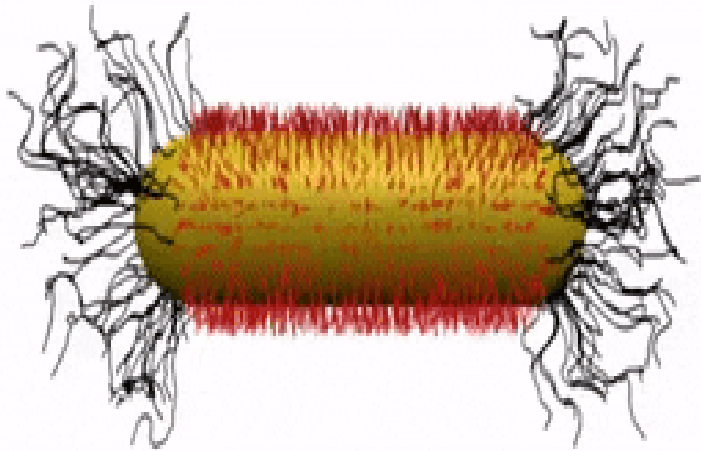
- Clean up oil spills, water and air pollution
- Reduce the cost of producing fuel cells and solar cells

NANOWIRES



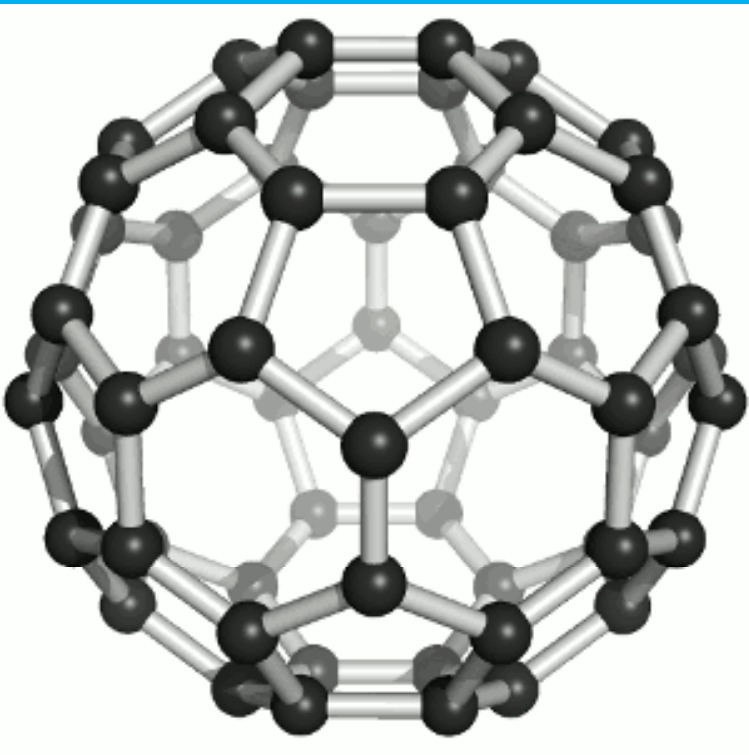
- Silver chloride - decomposes organic molecules in polluted water.
- Zinc oxide - flexible solar cells.
- Iron and nickel - make dense computer memory – RTM.

NANORODS



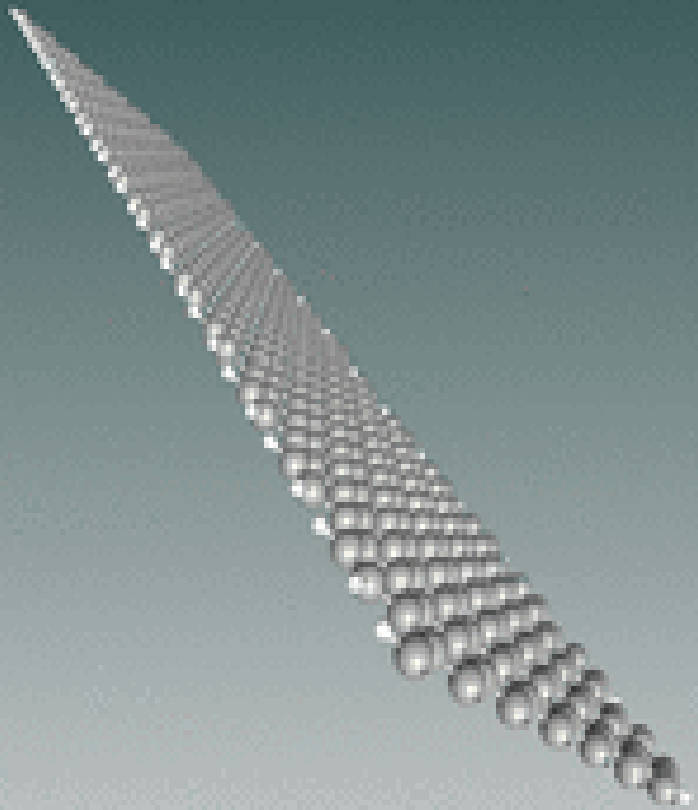
- ZnO NR – To fabricate nano-scale electronic devices – FET, UV photodetector, schottky diode and LED.
- Au-NR – Drug delivery, cell imaging, photothermal therapy for cancer (heated up, destroys the tumor cells) and liposuction.
- Metal catalysts involve Au, Cu, Ni and Sn.

FULLERENE NANOPARTICLES



- Can form conjugates with proteins and DNA – Anti-cancer treatments.
- Antioxidant in medicine.
- Incorporates fullerene in skin care products and cosmetics for achieving beneficial effects.

GRAPHENE NANORIBBONS



- Most promising model for future nanoelectronics
- Field effect transistors
- Schotkky diodes
- P-N junctions
- Light emitting diodes
- Solar cell systems
- Liquid crystals
- Transparent conductive electrodes

**GENE
DELIVERY**

**ELECTROCHEMICAL
BIOSENSORS**

**NANO-
CELLULOSE**

**NANO
TECHNOLOGY
IN
AGRICULTURE**

**RECENT
ADVANCES**

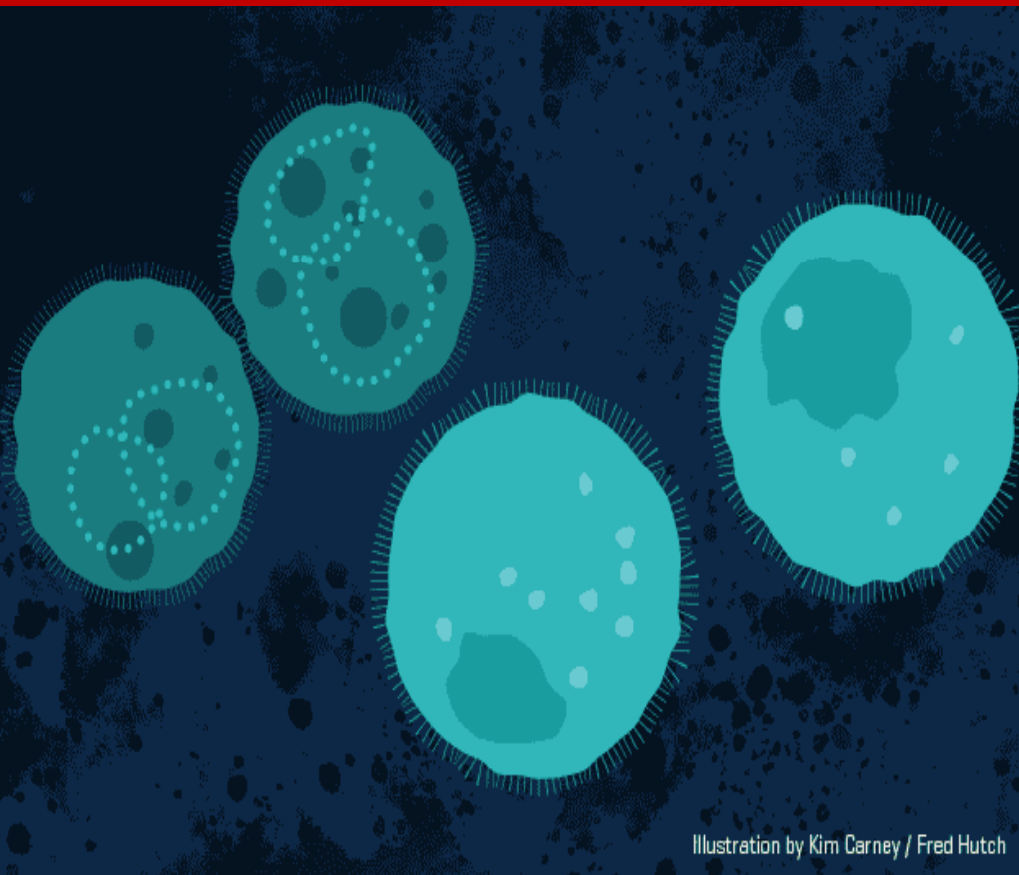
**MAGNETIC IRON
OXIDE NANO
PARTICLES**

NANOROBOTICS

**PH SENSITIVE
POLYMERIC
NANOPARTICLES**

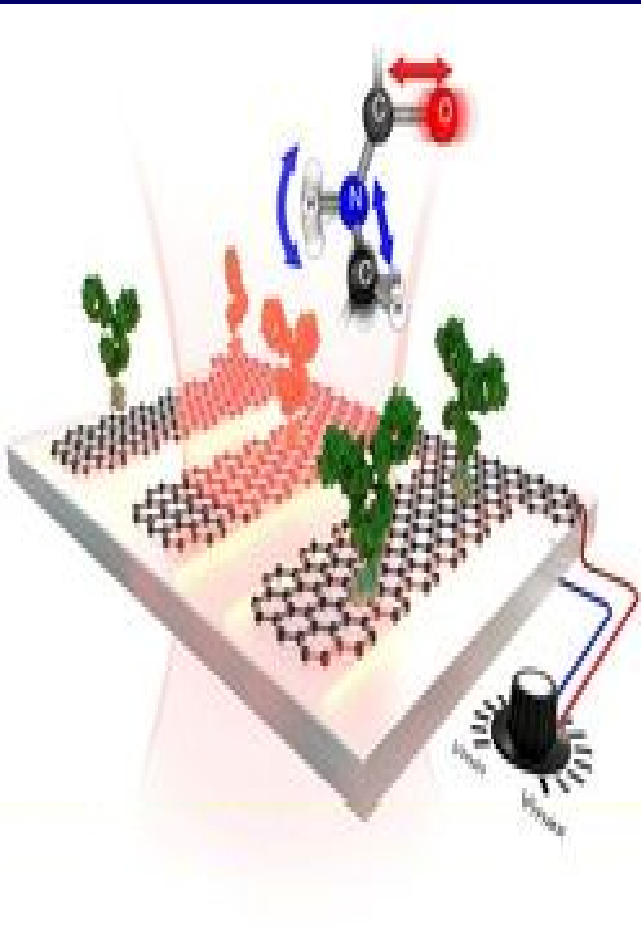
**CARBON BASED
NANO
TECHNOLOGY**

GENE DELIVERY



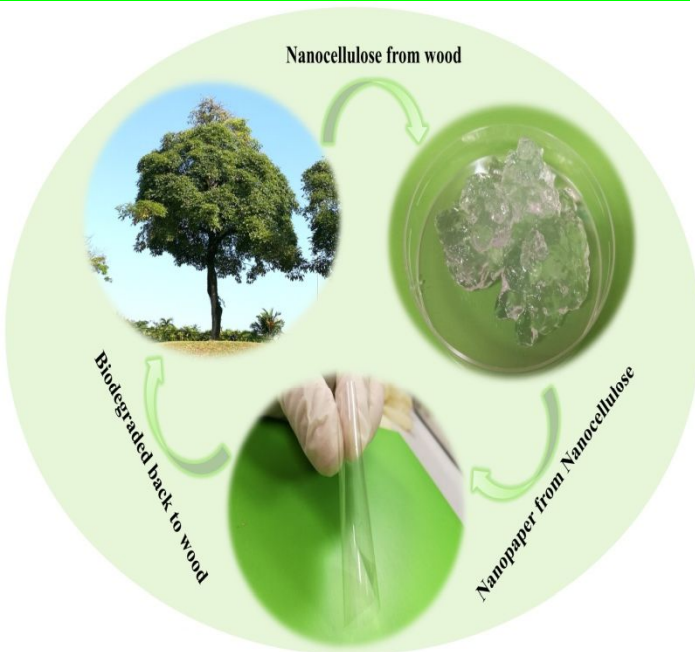
- Novel DNA and RNA delivery systems for gene therapy. (to cure diabetes –to overcome defective gene – create insulin)
- Best substitute for viral vectors
- Flexibility in design
- Low cytotoxicity

GRAPHENE 2D NANOMATERIALS- ELECTROCHEMICAL BIOSENSORS



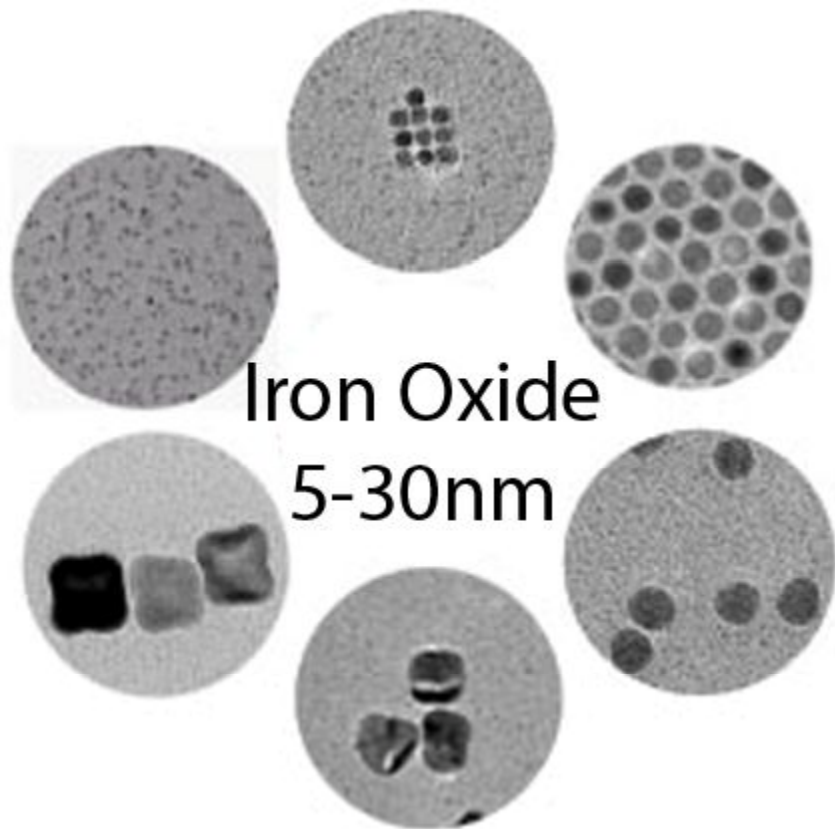
- Graphene and graphene-like 2D nanomaterials based electrochemical biosensors.
- Graphene-based enzyme biosensors, immunosensors, and DNA biosensors.
- Graphene-like 2D nanomaterials for electrochemical biosensing

NANOCELLULOSE-A VERSATILE GREEN PLATFORM



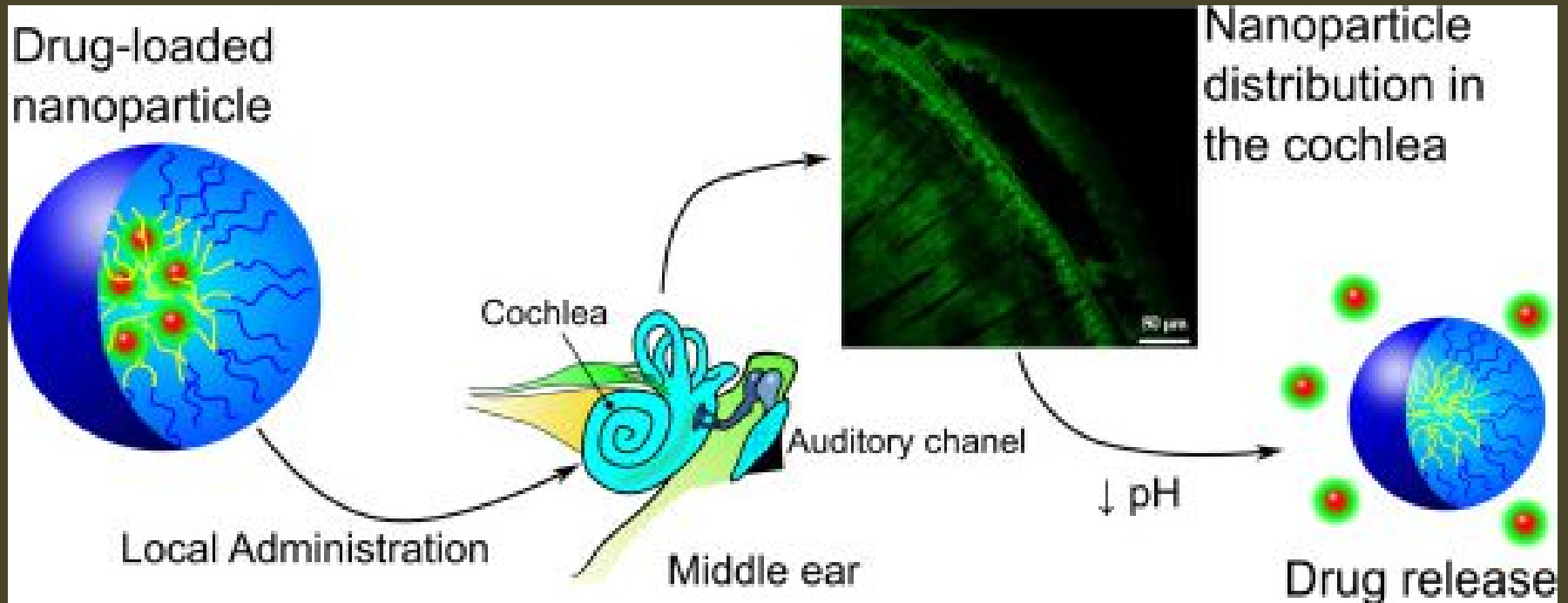
- functional paper
- optoelectronics and antibacterial coatings
- packaging
- mechanically reinforced polymer composites
- tissue scaffolds
- drug delivery
- biosensors
- energy storage
- catalysis
- environmental remediation
- electrochemically controlled separation

BIOMEDICAL APPLICATIONS OF MAGNETIC IRON OXIDE NANOPARTICLES



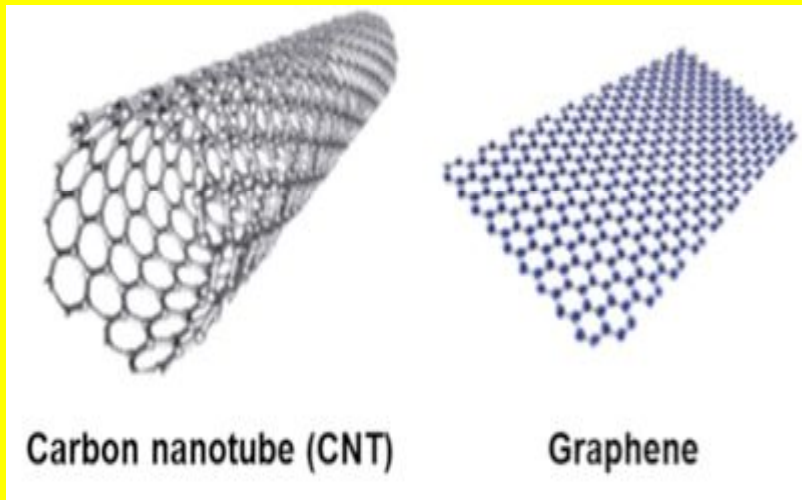
- **Magnetic resonance imaging**
- **Hyperthermia**
- **Drug delivery**
- **Tissue repair**
- **Cell and tissue targeting**
- **Transfection.**
- **Early detection of cancer, diabetes and atherosclerosis**

pH SENSITIVE POLYMERIC NANOPARTICLES



pH-sensitive polymeric nano-particles for tumor-targeting doxorubicin delivery in cancer chemotherapy

CARBON BASED NANOTECHNOLOGY



- Potential to replace conventional silicon based systems
- Recent research in
 - Carbon nanotubes growth, sorting and optoelectronics
 - New and surging area of graphene
 - Growth and properties of nanocrystalline diamond thin films



NANOROBOTICS



- **Nanorobotics - an emerging technology field creating robots at nanometre scale**
- **Future medical nanotechnology expected to employ nanorobots injected into the patient – blood vessel.**
- **Potential uses for nanorobotics in medicine:**
 - **early diagnosis and targeted drug-delivery for cancer**
 - **biomedical instrumentation- endoscopy**
 - **surgery**
 - **monitoring of diabetes**

NANOTECHNOLOGY IN AGRICULTURE



- Insect pests management through nanomaterials-based pesticides and insecticides
- Enhancement of agricultural productivity using bio-conjugated nanoparticles (encapsulation)
- Nanoparticle-mediated gene or DNA transfer in plants for the development of pest-resistant varieties
- Use of nanomaterials for preparation of different kind of biosensors

TECHNICAL BARRIER

**NANO
WEAPONRY**

TOXICITY

INSTABILITY

POSSIBLE RISKS

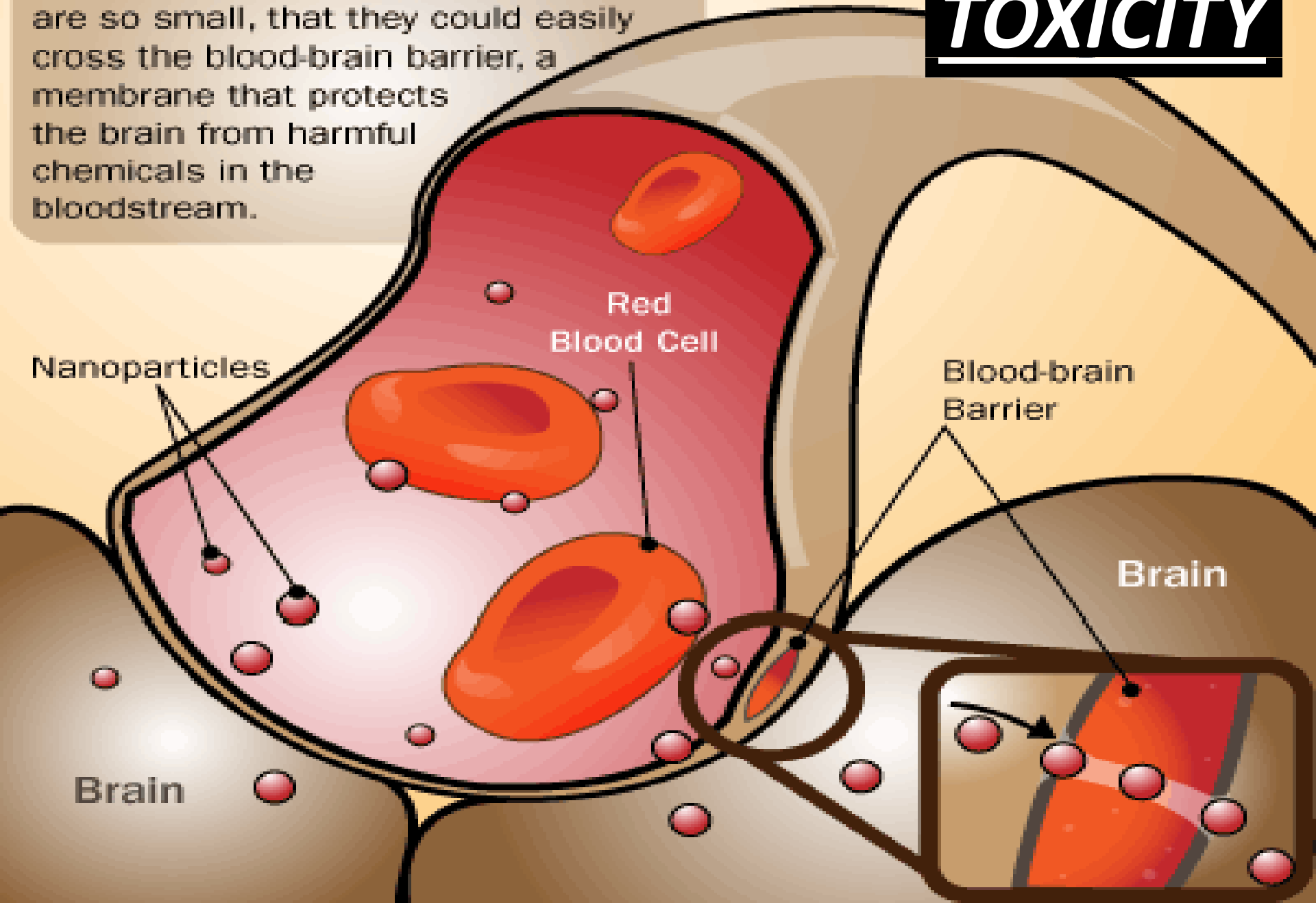
**BASIC
ISSUES**

IMPURITY

HEALTH ISSUES

TOXICITY

Some doctors worry that nanoparticles are so small, that they could easily cross the blood-brain barrier, a membrane that protects the brain from harmful chemicals in the bloodstream.



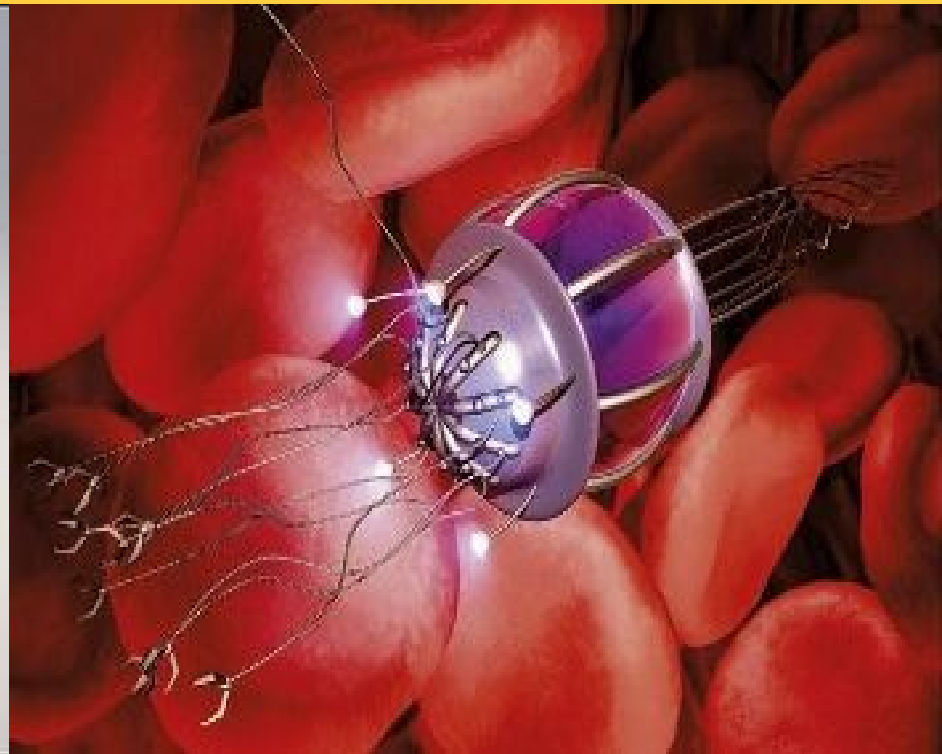
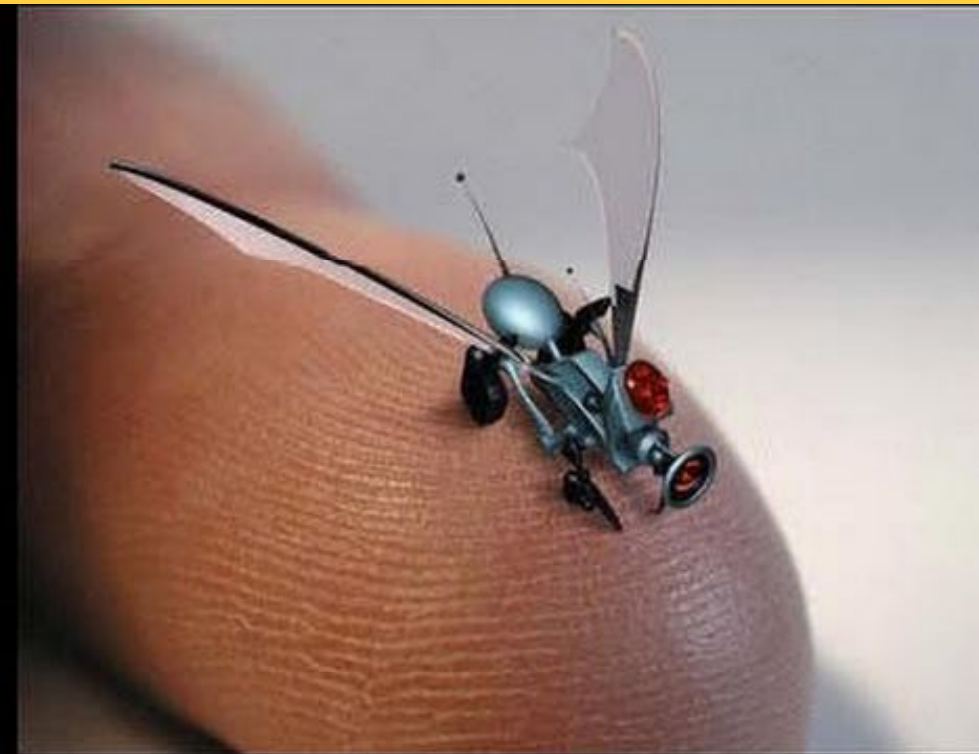
TECHNICAL BARRIER



Till today, Impossible to mass produce

- Nano-size transistors
- Nanowires
- Complex microprocessor chips

SOCIAL CONCERNS ABOUT NANO WEAPONRY



**Lethal and non-lethal powerful nano-weapons possible.
However Ethical implications of nano technology in
weaponry to be examined**

INSTABILITY OF NANO PARTICLES

- **prone to attack and undergo transformation**
- **poor corrosion resistance**
- **high solubility**
- **phase change of nanomaterials**

IMPURITY OF NANO PARTICLES

- **Strong interaction with impurities**
- **Reactive nano-entities engulfed by non reactive species**
- **Synthesis of pure nano particles - highly difficult**
- **Retaining high purity - a highly challenging task**

HARMFUL HEALTH ISSUES

- **Extremely harmful as nanoparticles are transparent to the cell dermis**
- **Toxicity due to high surface area and enhanced surface activity**
- **Causes Irritation**
- **Carcinogenic**
- **If trapped inside the lungs there is no way to expel out of the body**
- **Interaction with liver could be harmful**

Nanomaterials

Possible Risks

Carbon nanomaterials, silica nanoparticle

Pulmonary inflammation, granulomas, and fibrosis

Carbon, silver and gold nanomaterials

Distribution into other organs including the central nervous system

Quantum dots, carbon and TiO₂ nanoparticles

Skin penetration

MnO₂, TiO₂, and carbon nanoparticles

May enter brain through nasal epithelium olfactory neurons

TiO₂, Al₂O₃, carbon black, Co, and Ni nanoparticles

May be more toxic than micron sized particles



Thank you!