**National Journal of Multidisciplinary Research and Development**
**ISSN: 2455-9040**
**Impact Factor: RJIF 5.22**
**www.nationaljournals.com**
**Volume 3; Issue 1; January 2018; Page No. 956-958**

# Developments in the field of nano-technology

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**Abstract**
Lot of research work globally is in hand in the field of Nano-technology. In this paper author has explained, what nano-technology is. What all developments have already taken place? Which are the focus fields of nano-technology? What are the expectations from nano-technology etcetera.

**Keywords:** nano-technology, developments

## 1. Introduction

In present scenario the question before engineers/scientists is whether computers will ever be able to think like human being or robots will ever have human intelligence which has got 100 billion neurons. The answer is that the day is not far off when this will be a reality. It is predicted that by 2025 the robots will have human intelligence. The technology behind this success will be nanotechnology which uses nano materials.

Let us first talk what nano is. Nano is a Greek word which means Dwarf. A nano meter is one billionth part of a meter. Nanotechnology deals with materials of size 0.1 to 100 nanometer. To get sense of scale, a human hair measures 50,000 nanometers. A bacterial cell measures few 100 nanometers. A human eye can see 10,000 nanometers without any aid. Ten hydrogen atoms in line make up one nanometer.

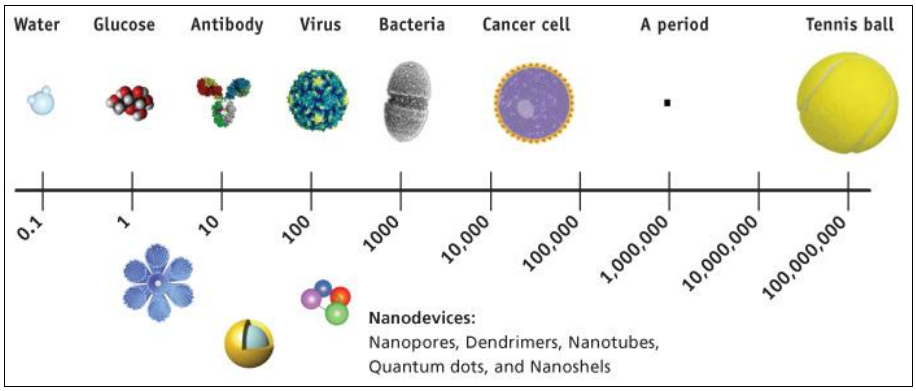


**Fig 1:** Real life objects of Nano Scale.

The products are made from atoms or molecules. The properties of these products depend on how these atoms are arranged. If we rearrange these atoms in coal we can make diamond.

If we rearrange atoms in sand we can make base material of computer chips. If we can rearrange atoms of dirt, water and air, we can make potatoes.

Nano science is study of fundamental principals of atoms and molecules. Nano technology is the application of nano structures. This also means technology to fabricate material devices circuits etc. where in individual phase or device present have dimensions falling in nano scale.

Today's manufacturing methods are very crude at atomic or molecular level. Casting grinding milling and even lithography moves atoms in great thundering herds. In future nanotechnology will let us manufacture atom by atom or molecule by molecule. The new generation of

Products using nanotechnology will be cleaner stronger lighter and more precise.

Right now focus of nano technology is on electronics, pharmaceuticals and medical sciences. We shall discuss role of nano technology in various fields.

**Fig.2:** Molecular Nano Structure.

**2. Molecular Electronics**

Molecular Electronics uses molecules as active device components. DNA is biological molecule which exists in nature and shows electronic properties. DNA and RNA are two molecules which are needed to form proteins. Protein molecule size is 2.5 nano meter.

Computer chips with protein based molecular sized circuits are still a fantasy. Yet reality has matched part of that dream as microprocessor have shrunk to the size of a nail and transistor been made from semi conductor polymers. DNA cell assemble components 1000 times as dense as best processing circuit and 100 times better than any storage circuit.

When molecules are placed between electrodes which are tiny conducting wires, electrons interact in the molecule. Molecules vibration in addition to electronic interaction produces transport channels. The electrons move through the molecules when it vibrates. When the oscillations of molecule are just right the electrons are pushed through more efficiently. Molecular electronic components have been developed in the form of logic gates, memory circuits, rectifiers, sensors, and number of other fundamental component.

Molecular electronics eliminates the tedious processing and manufacturing steps. Instead of building chips one component at a time. Designer will place the right ingredients in a beaker apply specific conditions and watch molecules assemble in proper order on the substrate.

Search is on for alternative materials from which nano scale circuits can be constructed. Sixty four bit Random Access Memory RAM is being perfected using bi-stable Rotaxine molecules, as memory element. Bi stable rotaxin works as molecular switch that can switch on and off depending upon the applied voltage.

**3. Living Electronics**

Living organism will be integral part of electronic circuits. Bacteria coated with gold nano particles have been used as humidity sensor. During the process the bacteria remained live.

**4. Neural Network on Chips**

Human brain is very good in pattern recognition and associated memory. Scientists in Germany have achieved a breakthrough. They have successfully contributed a hybrid circuit by connecting a semiconductor chip to two neurons of nerve cells taken from a pond snail. They established two way contact. The activity of neurons is on 100 µv pulse.

**5. Nano tubes**

Nano tubes are hollow thread of carbon. They look like a bit of rolled up microscopic chicken wire. Nano tubes are tiny tubes of carbon about 10,000 times thinner than human hair. The size of nano tube is less than 1nm.

They can be considered to be rolled up sheet of monolayer or multilayer carbon atoms bonded together in hexagon shape.

The chemical bond between carbon atoms in nanotube is stronger than diamond.

And cylindrical shape make nano tubes extra ordinary stiff. These nano tubes can be bent or twisted to any shape but will spring back to original shape when released.

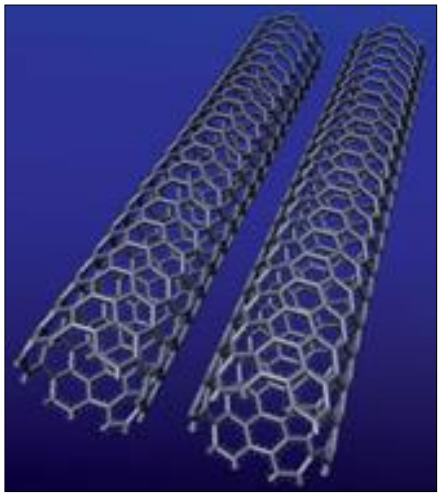

**Fig 3:** Carbon Nano tubes.

And hence crash proof car will be reality in future. Nano tubes are 50 times stronger than steel wire.

Nano tubes can be made into conducting metals a semiconductor depending upon how the sheet is rolled. Rolling at an angle, will form semiconductor material. Nano tubes conduct current much better than copper wire. It offers many exciting applications from microscopic wire to diodes and transistors. They can also carry heat more efficiently than diamond. Being very good conductor of heat nanotubes coating is done on microchips. Nanotubes are over 50 times stronger than steel wire. A single gram of single layer nanotube costs $750, about 70 times as much as gold is.

Factories manufacture nanotubes in gram scale only.
Nanotubes have been used in plastic body of cars to make it electrically conductive. Nanotubes have been used in piezo electric plastic material that produces voltage when pressed. By mixing nanotubes sensitivity of plastic shoots up by three times. When same are added in plastic solar cell it becomes 50000 times more efficient in converting solar energy into electrical energy. The versatile electrical properties of nanotubes and nanowires are now being used for the purpose of making nano scale electronic devices.

**6. Ultra-fast Nano electronic switch**
Somehow nanotube dimensions force water to solidify at room temperature. Nano switches are unable to function because electrons can easily jump the nano scale distance, when the current is switched off. However proton does not have any such problem. The proton current can be switched off more easily. So if a water filled nanotube is created whose diameter can be changed it is possible to have proton current switch. Freeze water the switch is on and liquefy water the switch is off.

**8. Nano technology in field of medicine**
Nano shells coated with polymer containing a tiny dose of insulin could be used to treat diabetics. A small cylinder containing millions of insulin coated nano shells could be implanted under patients' skin. The insulin would be released by infra red light focused at the place of cylinder. Polymer coating would melt and release the insulin.
Microscopic submarines injected into patient with a mission to travel to patents brain and would break up blood clot.

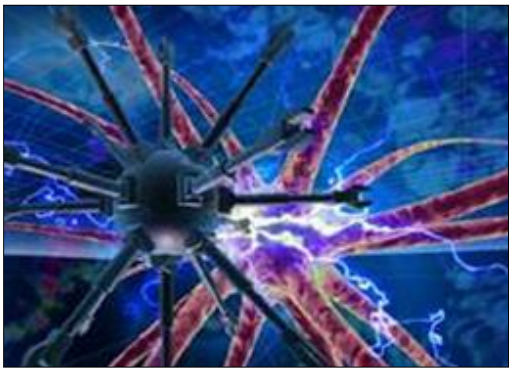

**Fig 4:** Nano Robots in Blood stream removing blood clot.

Submarines have been made to destroy cancer cells in the body.
Tiny artificial cells have been made to deliver drug directly to the part of the body where it is needed.
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**9. Toxicity fear**
It has been observed that nanotubes can damage lunges if inhaled. This was experimented on rats. Rats kept for 15 minutes in such atmosphere could not survive for more than four hours.

**10. Conclusion**
Nano technology like any other branch of science is primarily concerned with understanding that how nature works. The efforts to produce the devices and manipulated matter are still at very primitive stage compared to nature. Nanotechnology promises far more significant economic, military and cultural change than those created by internet.
Nanotechnology is one of the latest technical wonders which promise to change the way we are going to live.
Nanotechnology promises to make us healthy, wealthy and wise without consuming natural resources, without polluting the environment. It promises to build better, longer lasting, safe, smarter and cleaner products for our use in communication, medicine etc.

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