

---

# Nanotechnology The Industrial Revolution Of The 21st Century

## History

From the very beginning of human race man is becoming smarter, better and innovative. He has materialized those aspects that were beyond his limits. After the invention of fire and wheel a big revolution in many sector of science came. Introduction of gears was just a beginning of mechanical age which itself give rise to classical science and mechanics. Machines were developed, problem was that it requires large amount of resources for manufacturing. More space occupying, less efficiency, different environmental factors cause its working. In 1959, physicist Richard Feynman discussed about nanotechnology in his talk "There's Plenty of Room at the Bottom". In this talk he described how can we manipulate and work on atomic and molecular level. Professor Norio Taniguchi was the man who named nanotechnology. It was not explored much until 1981 when Gerd Binig and Heinrich Rohrer, invented scanning tunneling microscope (STM) which helped to work at nano scale. For this they got Nobel prize in 1986. After that within 20 to 25 years this "nano" took a "gargantuan" look in modern science era and is still developing and advancing. This is the role of nanotechnology which converted ENIAC (Electronic Numerical Integrator And Computer) into a simple computer and then laptop.

## Nature

Nanotechnology provides us a big space in a very small area and allows us to combine the billions of component in a very small area.

The computer manipulation works on Boolean logic gates (which refers 1 as true and 0 as false) but in computers practically it maintained by voltages with the help of transistors. The device that was used in ENIAC (first computer) for manipulation was vacuum tube (consisted of cathode and anode), this vacuum tube was bigger in size and less efficient. Only 20,000 transistors were occupying about 200 meters square space, weighted about 35 tons and consuming the electricity of about 20 houses an hours. Introduction of transistor (consisting semiconductors instead of electrodes) revolutionized the whole computer market. Today it just because of nanotechnology a single 2 cm square chip contains billions of transistors.

Nanotechnology is a branch that technically deals with the matter of size less 100 nanometers where one nanometer itself is one billionth of a meter. To get an idea about the nanometer make 25400000 pieces of an inch and just took one piece of it, this is a member of nano family.

---

## Need help with the assignment?

Our professionals are ready to assist with any writing!

[GET HELP](#)

---

A newspaper's thickness is about 100,000 nanometers.

Nanotechnology in simple words is the manipulation of matter at atomic and molecular scale. At nano level some surprising properties of atoms and molecules can be observed like heat, electricity, optical and many more.

Now working on such nano scale is a big job because manipulation, driving, energy storing are some factors that resist the big and quick change in nano world. AFM (Atomic Force Microscopy) helps to understand the shape by proper topographic imaging. AFM is the modified version of STM.

## How to Get Into Nano World

AFM (Atomic Force Microscopy) helps to gather information of any nanoparticle also it gives a proper overview about shape, size and properties.

### Main Components of AFM

- **Cantilever:** It is made of Si<sub>3</sub>N<sub>4</sub> OR Si. It is the most important component of AFM which reads the surface. It is used for scanning surface. Resolution of image depends on sharpness of tip, sharper the tip sharper valleys will be detectable.
- **Force Sensors:** These sensors calculate the force between Cantilever Tip and the Sample.
- **Light Lever Sensor:** it monitors cantilever deflection. Laser beam shows deflection whenever cantilever shows motion.
- **Feedback Control:** it creates a fixed relationship between probe and surface and ensures to not get away from path. And gives a feedback to the system.

It creates a geographic model of the particle by simply "touching, feeling and tapping". By touching means a tip just touches surface and dragged over the surface gently and smoothly, corresponding a three dimensional topographic image is formed, while the case of feeling means a constant distance is maintained between the tip and the surface of the nano particle. But tapping method is a combination of both. Motion of cantilever is proportional to the output from photo detector.

### Contact Mode

In this mode the cantilever moves over the surface and keeps a contact throughout the observation. It is just like movement of bristle of paint brush over a rough surface from different

---

### Need help with the assignment?

Our professionals are ready to assist with any writing!

[GET HELP](#)

---

directions and gently tracing its path at each instant. The locus of bristle taken as a feedback gives rise to a topographic image which tells about its shape and size. A laser beam is projected over cantilever and then movement of laser beam reflected from cantilever is recorded over a photodiode, this creates same pattern of peak and valleys that tip analyses.

## Advantages

- Due to motion of tip in a particular direction its scanning speed is very high.
- Helps to find the strength of sample pieces sometimes the viruses as well.
- Resolution at atomic level is possible.
- Disadvantages
- Tip sliding over surface, damages the sample due to which resolution of sample gets affected.
- The lateral forces like friction and adhesive causes some unwanted movements due to which the sample gets affected.
- The capillary forces also affect the tip and the sample.

## Non Contact Mode

In this mode the tip moves just above the sample surface maintaining a constant distance from it. As the tip approaches the range of attractive forces of sample surface the tip bend toward the sample and it is brought closest range when repulsive forces comes to play which pushes it back from the sample surface. Now the cantilever is maintained in such a way that it counters both the situation and maintains a constant distance between the sample and the surface.

Then a laser beam is again projected and recaptured by the sensors, and forms a topographic 3D model.

## Advantages

- There is no direct contact between surface and cantilever tip hence no damage occurs.
- No effects of lateral forces.
- Lateral resolution minimizes.
- To avoid contact slow scanning.

## Tapping Mode

In this mode cantilever oscillate at its resonating frequency. An electronic feedback loop maintains amplitude of oscillation. This avoids the damaging of sample. Force oscillation and

---

## Need help with the assignment?

Our professionals are ready to assist with any writing!

**GET HELP**

---

amplitude which helps in detecting different kind of forces. It is actually combination of other two.

## Advantages

- Due to oscillation, time period of forces and its effect reduces.
- Resolution of sample increases.
- Damage of sample reduces and slow scanning speed.
- Manufacturing
- Manufacturing at nanoscale is challenging job. It is very important because it decides strength, structure and properties of material. There are two methods

## Molecular Beam Epitaxy

Mostly use method for manufacturing high quality transistors and semiconductors. This method provides control over atomic composition. Low energy and ultra-high vacuum deposition technique is used in this method. In this method substrate is placed in main chamber after removing impurities and then it is heated. And then plasma oxygen bombard over it and reflection high energy electron diffraction for substrate's surface real time analysis. Then film of different material can be grown.

## Atomic Layer Epitaxy

Microelectronic devices, solar cell, capacitors and ultrathin corrosion resistant devices are made by ALE. This method controls the thickness and makes uniform layer of different material. ALT chamber consists of heater for desired despoising temperature. Film growth can be monitored by quartz crystal. Precursor (reacting species) enters by carrier gas. And a vacuum pump for low pressure. Precursor gets deposited on the surface of substrate. And an ultra-thin layer is formed.

In this method tip deposits nano material over substrate with a pin dipped in required chemical material. Its working is just like fountain pen. This method is used for making conducting polymers, silicon nanostructure and nano particle lines.

As the name suggests the printing or stamping over substrate is done by this method. This method reduces time and cost of manufacturing as it is used when we require similar material.

In this method small nano particles form some stable structure by means of spontaneous or natural mechanism. Required raw atoms and molecules are combined with specially arranged

---

## Need help with the assignment?

Our professionals are ready to assist with any writing!

**GET HELP**

---

and oriented molecules or atoms by chemical process.

After reaching nanoscale and its manufacturing, delivering instructions and work accordingly maintains its difficulty at this scale. Different designs operated differently. For example,

Scientists had designed a nanobot for eye surgeries which can fit into a syringe needle. This nanobot can travel through any eye part. But it is difficult to add energy or propellers so basically driven by externally generated electromagnets (octomag). These eight electromagnets can move nanobot in any direction. This nanobot contains some medicine within which it can inject at any part of eye. Similar kind of nanobot has been designed for treatment of diseases occurs in any sensitive part of the body for example blood vessels. This is on working stage and tested on pig's eye.

Latest research shows that we use resources with same rate as today then population will be colonize in two planets by 2050. Use of resources at nanoscale will not secure them for future.

## Nanotubes

Carbon nanotube are made by grapheme, it is one atom thick sheet derived from graphite. Which can conduct electricity faster than any other material at room temperature. When grapheme is wrapped in cylindrical form it form tubes like structure which are tougher than steel, lighter than aluminum and more conductive than copper.

## Ultra Ever Dry

It is a highly hydrophobic coating that repels water and refined oil using nanotechnology. Different devices. In this omniphobic technique is used for which creates some chemical phenomena and geometry which repels water and some oils.

## Conclusion

Revolution at nanoscale is unstoppable, and we are going to face it in current century. Medical, defense, energy, chemistry, physics, space it is going to control almost all sectors. This nano science is very important for us as it can help us to fix resource and energy crisis. In the field of medical science it will cure many incurable diseases like cancer. It is going to replace many hard material and current conducting materials. Nanoparticle are very helpful for understanding optical behavior of the atoms and molecules hence we can think of a future technology which could make concept of invisibility possible. What I think as in modern science the physics of the tiny particles is completely different, seems pretty magical and highly advance from the science

---

## Need help with the assignment?

Our professionals are ready to assist with any writing!

**GET HELP**

---

that applies on bigger objects around us. In the same way simple mechanism of nanoparticles can drive us to any extraordinary task.

But its disadvantages are unbelievable, think about a nanocam which could make a big question mark on our privacy. A nano killer machine, which can inject anything in body. Weapons at atomic and molecular scale are highly destructible. Manufacturing on such small scale causes pollution of nearly same scale which can cause problems like skin, lungs, eyes etc.

This technology can be boon for us if used sincerely but could be curse for humanity as well if used for destruction.

gradesfixer.com

---

### **Need help with the assignment?**

Our professionals are ready to assist with any writing!

**GET HELP**