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NANO Technology

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ABSTRACT

A basic definition of Nanotechnology is the study manipulation and manufacture of extremely minute machines or devices. These devices are so small to the point of manipulating the atoms themselves to form materials .By this Nanotechnology we can make computers billions of times more full than today’s and new medical capabilities that will heal and cure in cases that are now viewed as utterly hopelessly. The properties of manufactured products depend on how those atoms are arranged. If we know about exactly how many dopant atoms are in a single transistors and exactly where each individual dopant atom is located and placed roughly the right number in roughly the right place, we can make a working transistor. Another improvement in Nanotechnology is self-replication. Self-replication makes an effective route to truly low cost manufacturing. Our intuitions about self-replicating systems learned from biological systems that surround us are likely to seriously mislead us about the properties and characteristics of artificial self replicating systems designed for manufacturing purposes. Artificial systems able to make a wide range of Nano biological products like diamond under programmatic control are likely to be more brittle and less adaptable in their response to changes in their environment than biological systems. At the same time they should be simpler and easier to design. Thus the progress of technology around the world has already given us more precise, less expensive manufacturing technologies that can make an unprecedented diversity of new products.

I. INTRODUCTION

The term "nanotechnology" has evolved over the years via terminology drift to mean "anything smaller than micro technology," such as Nano powders, and other things that are Nano scale in size, but not referring to *mechanisms* that have been purposefully built from Nano scale components. See our "Current Uses" page for examples. This evolved version of the term is more properly labeled "Nano scale bulk technology," while the original meaning is now more properly labeled "molecular nanotechnology" (MNT), or "Nano scale engineering," or "molecular mechanics," or "molecular machine systems," or "molecular manufacturing." Recently, the Foresight Institute has suggested an alternate term to represent the original meaning of Nano technology: zeta technology.

At the most basic *technical* level, MNT is building, with intent and design, and molecule by molecule, these two things: 1) incredibly advanced and extremely capable Nano-scale and micro-scale machines and computers, and 2) ordinary size objects, using other incredibly small machines called assemblers or fabricators (found inside manufactories). In a nutshell, by taking advantage of quantum-level properties, MNT allows for unprecedented control of the material world, at the Nano scale, providing the means by which systems and materials can be built with exacting specifications and characteristics. Or, as Dr. K. Eric Drexler puts it "large-scale mechano synthesis based on positional control of chemically reactive molecules."

MNT represents the state of the art in advances in biology, chemistry, physics, engineering, computer science and mathematics. The major research objectives in MNT are the design, modeling, and fabrication of molecular machines and molecular devices. The emergence of MNT - both infant and mature - has numerous social, legal, cultural, ethical, religious, philosophical and political implications.

At the most basic social level, MNT is going to be responsible for massive changes in the way we live, the way we interact with one another and our environment, and the things we are capable of doing.

II. Process of NANO Technology

Nano manufacturing indicates the various methods companies are using to a make the advanced materials and devices enabled by nanotechnology. At the core, Nano manufacturing is a collection of processes that can control assembly at the Nano-scale to produce novel devices and materials. Microprocessors are a great example of nano manufacturing, but semiconductor manufacturers primarily uses one category of nano manufacturing called top-down processing. Other examples of include the super capacitors made of carbon nanotubes. Here, carbon nanotubes are grown from the surface of the electrode, representing a bottom-up fabrication process.

Top-down is common in semiconductor manufacturing and uses the addition or removal of layers to build devices or electronics. By cyclically adding and removing layers of material Nano manufacturers can construct complex devices. Bottom-up nano manfucturing, on the other hand, is where material or complexes are assembled through natural forces and self-organization. The most complex examples of bottom-up fabrication are plants and animals, however, scientists still struggle to produce examples beyond the most basic structures and length-scales. In either case, does not mean that the product is always 'Nano' in scale. For example, Nano comp has produced 16 gauge wire woven from carbon nanotubes (Figure 1).

Figure 1. Nano comp has produced 16 gauge wires from spun carbon nanotubes (link).

A recent report by the United States Government Accountability Office (GAO) has identified as the next technological mega-trend, with the capability of exceeding current manufacturing capabilities (figure 3). Unlike previous technological revolutions, such as the personal computer or the internal combustion engine, nanotechnology is a fundamental change in manufacturing processes; much like digital processing was for how electronics worked. Nano manufacturing, however, will result in new materials and products with capabilities beyond that currently accessible. A recent report by the McKinsey Global Institute, estimated the impact of advanced materials alone will be between \$150 and \$500 Billion by 2025. Lux Research's recent report noted that nanotechnology-based products have produced roughly \$2 Trillion in revenue in 2013. The National Nanotechnology Initiative (NNI) is also supporting the revolution transition. The National Nano manufacturing Network (NNN) is an alliance of academic, government and industry partners that cooperate to advance strength in the United States.

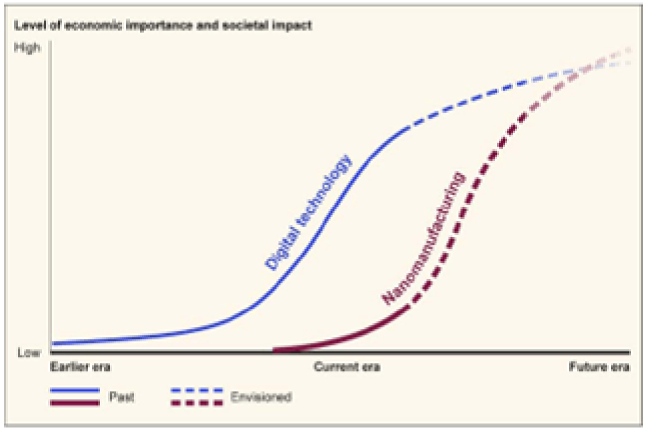
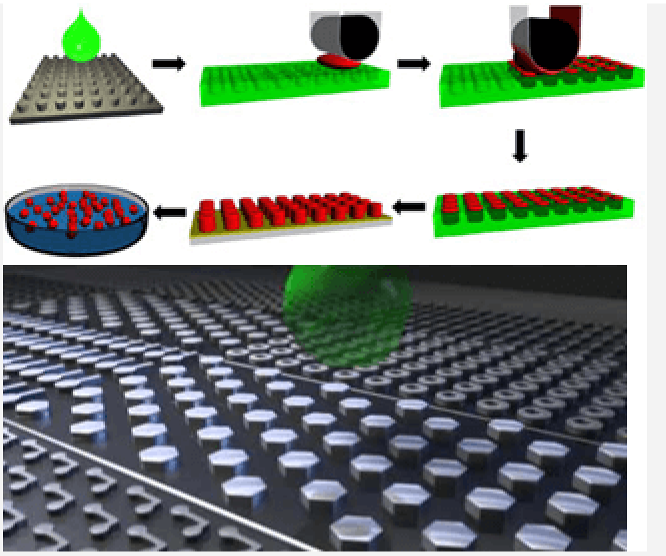


Figure 3. GAO's projection of capability over the recently realized digital technology revolution.

Some examples of nano manufacturing methods include; Photolithography, Chemical Vapor Deposition (CVD), Molecular Beam Epitaxy (MBE), Dip-pen Lithography (DPN), Roll-to-Roll Processing, and Self-assembly. These methods, and many more, are used to produce products such as touch-screens, anti-microbial coatings, or elite sporting equipment.

The current challenge is scale-up of these processes. The majority of techniques were developed for research applications. This means that the equipment is low-volume, designed to be flexible, and require a competent operator. Commercial-scale manufacturing equipment requires high volume, minimal operator interaction, and needs to focus on producing the same product every time. Also, a lot changes when you move from a bench-top to high-volume production; heating methods change, batch processes transition to continuous processes, and the level of automation increases. It takes a lot of innovation, time, and money to cross these technology gaps.

Some companies have already overcome the challenges associated with. Liquidia, for example, uses a roll-to-roll technology called PRINT®. PRINT® technology leverages molds and advanced flouro-polymers to reliably produce nanoparticles with custom size, shape, and chemical composition. Alternatively, Nano film uses a variety of deposition techniques to produce self-reactive thin films are ultrathin and invisible on a surface. With just a thin layer, however, Nano film can make it easier to clean your table, not smudge your iPhone, or reduce glare while driving. On a larger scale, companies like BASF and Eastman Chemical have leveraged their chemical processing skill to produce nanoparticles and quantum dots.



III. Applications

The ability to see Nano-sized materials has opened up a world of possibilities in a variety of industries and scientific endeavors. Because nanotechnology is essentially a set of techniques that allow manipulation of properties at a very small scale, it can have many applications, such as the ones listed below.

Drug delivery. Today, most harmful side effects of treatments such as chemotherapy are a result of drug delivery methods that don't pinpoint their intended target cells accurately.

Researchers at Harvard and MIT have been able to attach special RNA strands, measuring about 10 nm in diameter, to nanoparticles and fill the nanoparticles with a chemotherapy drug. These RNA strands are attracted to cancer cells. When the nanoparticle encounters a cancer cell it adheres to it and releases the drug into the cancer cell. This directed method of drug delivery has great potential for treating cancer patients while producing less side harmful effects than those produced by conventional chemotherapy.

Fabrics. The properties of familiar materials are being changed by manufacturers who are adding Nano-sized components to conventional materials to improve performance. For example, some clothing manufacturers are making water and stain repellent clothing using Nano in the fabric that cause water to bead up on the surface.

Reactivity of Materials. The properties of many conventional materials change when formed as Nano-sized particles (nanoparticles). This is generally because nanoparticles have a greater surface area per weight than larger particles; they are therefore more reactive to some other molecules. For example studies have shown that **nanoparticles of iron can be effective in the cleanup of chemicals in groundwater** because they react more efficiently to those chemicals than larger iron particles.

Strength of Materials. Nano-sized particles of carbon, (for example nanotubes and bucky balls) are extremely strong. Nanotubes and bucky balls are composed of only carbon and their strength comes from special characteristics of the bonds between carbon atoms. One proposed application that illustrates the strength of nanosized particles of carbon is the manufacture of t-shirt weight **bullet proof vests made out of carbon nanotubes**.

Micro/Nano ElectroMechanical Systems. The ability to create gears, mirrors, sensor elements, as well as electronic circuitry in silicon surfaces allows the manufacture of miniature sensors such as those used to activate the airbags in your car. This technique is called MEMS (Micro-ElectroMechanical Systems). The MEMS technique results in close integration of the mechanical mechanism with the necessary electronic circuit on a single silicon chip, similar to the method used to produce computer chips. Using MEMS to produce a device reduces both the cost and size of the product, compared to similar devices made with conventional methods. MEMS are a stepping stone to NEMS or Nano-ElectroMechanical Systems. NEMS products are being made by a few companies, and will take over as the standard once manufacturers make the investment in the equipment needed to produce Nano-sized features.

Molecular Manufacturing. If you're a Star Trek fan, you remember the replicator, a device that could produce anything from a space age guitar to a cup of Earl Grey tea. Your favorite character just programmed the replicator, and whatever he or she wanted appeared. Researchers are working on developing a method called molecular manufacturing that may someday make the Star Trek replicator a reality. The gadget these folks envision is called a molecular fabricator; this device would use tiny manipulators to position atoms and molecules to build an object as complex as a desktop computer. Researchers believe that raw materials can be used to reproduce almost any inanimate object using this method.

IV. The Future of Nano Technology

The future of nanotechnology is completely uncharted territory. It is almost impossible to predict everything that Nano science will bring to the world considering that this is such a young science.

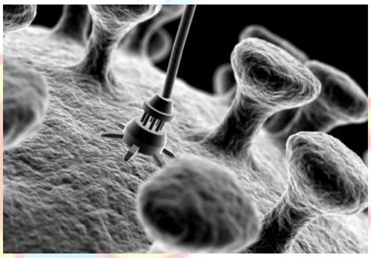
There is the possibility that the future of nanotechnology is very bright, that this will be the one science of the future that no other science can live without. There is also a chance that this is the science that will make the world highly uncomfortable with the potential power to transform the world.

Even positive changes can make world leaders and citizens alike very nervous. One of the top concerns regarding the future of Nano science includes molecular manufacturing, which would be the ability to bring materials to life from the simple molecular reconstruction of everyday objects.

This technology could end world hunger. At the same time, this process could lead to experimental molecular manufacturing with live beings.

The future of nanotechnology could improve the outlook for medical patients with serious illnesses or injuries. Physicians could theoretically study Nano surgery and be able to attack illness and injury at the molecular level. This, of course, could eradicate cancer as the surgical procedures would be done on the cellular base.

Cancer cells would be identified, removed, and the surgical implantation of healthy cells would soon follow. Moreover, there would be an entire Nano surgical field to help cure everything from natural aging to diabetes to bone spurs. There would be almost nothing that couldn't be repaired (eventually) with the introduction of Nano surgery.



While this sounds like a promising future, the natural process of life and death would be completely interrupted. Without death, the world would become overpopulated and leave no place for the ecosystems that we rely on for our survival. We could potentially end up in a world that requires the personally controlled delivery of oxygen through tanks and masks.

The future of nanotechnology could very well include the use of Nano robotics. These Nano robots have the potential to take on human tasks as well as tasks that humans could never complete. The rebuilding of the depleted ozone layer could potentially be able to be performed.

V. Conclusion

Nanotechnology is a brand new technology that has just begun; it is a revolutionary science that will change all what we knew before. The future that we were watching just in science fiction movies will in the near future be real. This new technology will first of all, keep us healthy because of Nano robots that will repair every damage that we have in our body. Secondly it will give scientists the ability to manipulate the combination of atoms in an object and to turn it into a lighter, stronger, and more durable object than before, just by using carbon nanotubes that are known to be a hundred times stronger than steel and in addition to that they are very flexible. That will lead to the creation of objects that can change their forms and have multiple purposes as the Nokia Morph for example which is a prototype that will soon be out on the market. Thirdly, Nanotechnology will give us an abundant energy because it will transform energy more effectively, for example windmills which are known to have the ability to transform wind energy into electrical energy, well new windmills that will use Nanotechnology will have lighter and stronger blades (using carbon nanotubes) that will transform a lot more energy than before.

Nanotechnology covers a lot of domains today and will cover a lot more in the near future, it is infinitely big and will make a lot of inventions come true like teleportation for example which scientists are working on today.

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