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NANOTECHNOLOGY: A REVOLUTION IN TECHNOLOGY FOR THE WORLD

Harjeet Singh Mehta[1], Dilip Kumar[2], Sana Naaz[3]

[1,2,3]*Computer Science and Engineering Department,*
Tulas Institute of Engineering and Management College, Dehradun, (India)

ABSTRACT

Nanotechnology, despite of its fantastic sounding name, is actually very practical for developing countries to make product better and cheaper. Technical innovations help countries in developing economies and strengthen market robustness and build new profitable industry bases for these countries. Nanotechnology is helping to considerably improve, even revolutionize, many technology and industry sectors: information technology, energy, environmental science, medicine, homeland security, food safety, and transportation and many others. Nanotechnology has the potential to revolutionize the scientific world by allowing scientists to manipulate matter at atomic or molecular scale and by combining their knowledge base in physics, engineering, chemistry and biology. Nanotechnology, make our lives more secure, improve healthcare delivery, and optimize our use of limited resources. Mankind has spent millennia trying to fill these needs, because it has always known that these are the things which are necessary to ensure the future for itself. If nanotechnological applications goes in the direction they are headed, we are one step closer for ensuring the future. Now, it is the time that nanotechnology is taken seriously before competition builds up across the world.

Keywords: Robustness, Millennia, Mechanochemistry, Personal Nanofactories, Grey-Goo, Cell, Molecule, Nanobiosystems.

I. INTRODUCTION

The word 'nanotechnology' is evolved in the year 1980's by K. Eric Drexler, he was talking about building machines on the scale of molecules, a few nanometers wide- robots, arms, and even whole computers, far smaller than a cell. Drexler spent the next ten years describing and analyzing these incredible devices, and responding to accusations of science fiction. The **U.S.National Nanotechnology Initiative** was created to fund this kind of nanotech: their definition includes anything smaller than 100 nanometers with novel properties.

Nanotechnology is the engineering of tiny machines — the projected ability to build things from the bottom up inside **personal nanofactories** (PNs), using techniques and tools being developed today to make complete, highly advanced products. Ultimately, nanotechnology will enable control of matter at the nanometer scale, using **mechanochemistry**. Shortly after this envisioned molecular machinery is created, it will result in a manufacturing revolution, probably causing severe disruption. It also has serious economic, social, environmental, and military implications.

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A nanometer is one billionth of a meter, roughly the width of three or four atoms. The average human hair is about 25,000 nanometers wide.

Much of the work being done today that carries the name 'nanotechnology' is not nanotechnology in the original meaning of the word. Nanotechnology, in its traditional sense, means building things from the bottom up, with atomic precision.

I want to build a billion tiny factories, models of each other, which are manufacturing simultaneously. . . The principles of physics, as far as I can see, do not speak against the possibility of maneuvering things atom by atom. It is not an attempt to violate any laws; it is something, in principle, that can be done; but in practice, it has not been done because we are too big. **Richard Feynman,** Nobel Prize winner in physics

Nanotechnology is sometimes referred to as a *general-purpose technology*. That's because in its advanced form it will have significant impact on almost all industries and all areas of society. It will offer better built, longer lasting, cleaner, safer, and smarter **products** for the home, for communications, for medicine, for transportation, for agriculture, and for industry in general.Asnanotechnology is also termed as general purpose technology, it will be dual use i.e. it will have many commercial uses and it also have many military uses in making far more powerful weapons and tools of surveillance. Thus it represents not only wonderful benefits for humanity but it also grave risks. Nanotechnology not only will allow making many high-quality products at very low cost, but it will allow making new nanofactories at the same low cost and at the same rapid speed. This unique ability to reproduce its own means of production is why nanotech is said to be an *exponential* technology.

To understand the nanotechnology we should also have the full knowledge of the terms related with nanotechnology. So, we first begin with –

II. PERSONAL NANOFACTORIES

It's a proposed new appliance, something that might sit on a countertop in your home. To build a personal nanofactory (PN), you need to start with a working fabricator, a nanoscale device that can combine individual molecules into useful shapes. A fabricator could build a very small nanofactory, which then could build another one twice as big, and so on. Within a period of weeks, you have a tabletop model.Products made by a PN will be assembled from nanoblocks, which will be fabricated within the nanofactory.

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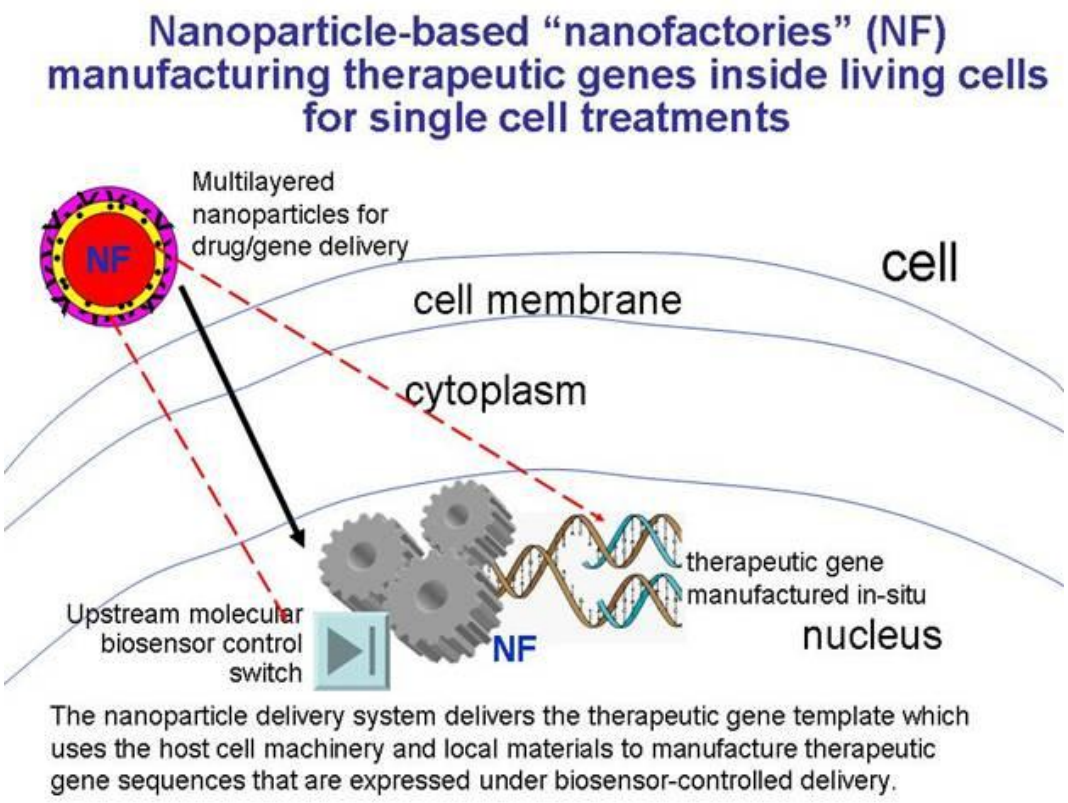

III. NANOFACTORIES PRODUCE

- Lifesaving medical robots *or* untraceable weapons of mass destruction.
- Networked computers for everyone in the world *or* networked cameras so governments can watch our every move.
- Trillions of dollars of abundance *or* a vicious scramble to own everything.
- Rapid invention of wondrous products *or* weapons development fast enough to destabilize any arms race.
- After getting knowledge about nanofactories the next term is **mechanochemistry**.

IV. MECHANOCHEMSITRY

It's a bit like enzymes (if you know your chemistry): you fix onto a molecule or two, then twist or pull or push in a precise way until a chemical reaction happens right where you want it. This happens in a vacuum, so you don't have water molecules bumping around. It's a lot more controllable that way.

So, if you want to add an atom to a surface, you start with that atom bound to a molecule called a "tool tip" at the end of a mechanical manipulator. You move the atom to the point where you want it to end up. You move the atom next to the surface, and make sure that it has a weaker bond to the tool tip than to the surface. When you bring them close enough, the bond will transfer. This is ordinary chemistry: an atom moving from one molecule to another when they come close enough to each other, and when the movement is energetically favorable. What's different about mechanochemistry is that the tool tip molecule can be positioned by direct

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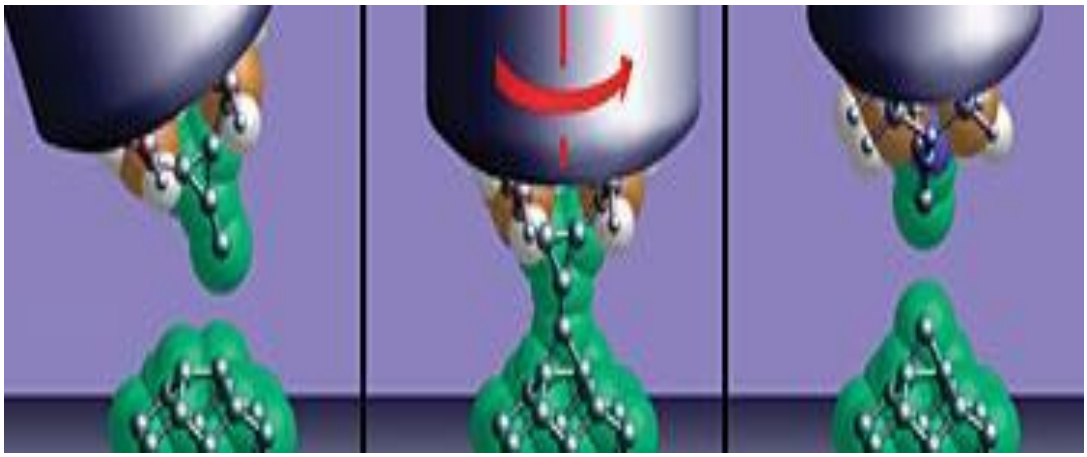
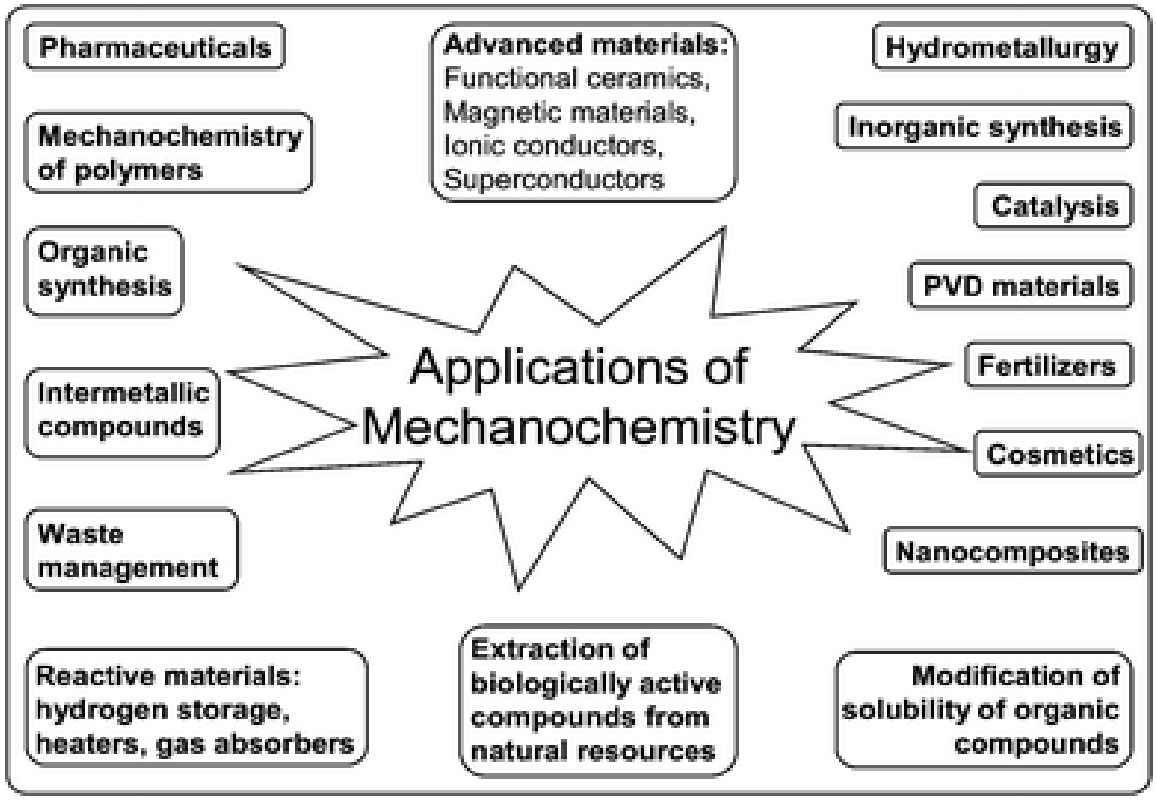
computer control, so you can do this one reaction at a wide variety of sites on the surface. Just a few reactions give you a lot of flexibility in what you make.



V. MECHANOSYNTHETIC REACTIONS



VI. BENEFITS OF NANOTECHNOLOGY

The benefits of nanotechnology depend on the fact that it is possible to tailor the essential structures of materials at the nanoscale to achieve specific properties, thus greatly extending the well-used toolkits of materials science.Using nanotechnology, materials can effectively be made to be stronger, lighter, more durable, more reactive, more sieve-like, or better electric conductors, among many other traits. There already exist over 800 everyday commercial products that rely on nanoscale materials and processes:

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- Nanoscale additives in polymer composite materials for baseball bats, tennis rackets, motorcycle helmets, automobile bumpers, luggage, and power tool housings can make them simultaneously lightweight, stiff, durable, and resilient.
- Nanoscale additives to or surface treatments of fabrics help them resist wrinkling, staining, and bacterial growth, and provide lightweight ballistic energy deflection in personal body armor.
- Nanoscale thin films on eyeglasses, computer and camera displays, windows, and other surfaces can make them water-repellent, antireflective, self-cleaning, resistant to ultraviolet or infrared light, antifog, antimicrobial, scratch-resistant, or electrically conductive.
- Nanoscale materials in cosmetic products provide greater clarity or coverage; cleansing; absorption; personalization; and antioxidant, anti-microbial, and other health properties in sunscreens, cleansers, complexion treatments, creams and lotions, shampoos, and specialized makeup.
- Nano-engineered materials in the food industry include nanocomposites in food containers to minimize carbon dioxide leakage out of carbonated beverages, or reduce oxygen inflow, moisture outflow, or the growth of bacteria in order to keep food fresher and safer, longer. Nanosensors built into plastic packaging can warn against spoiled food.
- Nano-engineered materials in automotive products include high-power rechargeable battery systems; thermoelectric materials for temperature control; lower-rolling-resistance tires; high-efficiency/low-cost sensors and electronics; thin-film smart solar panels; and fuel additives and improved catalytic converters for cleaner exhaust and extended range.
- Nanostructured ceramic coatings exhibit much greater toughness than conventional wear-resistant coatings for machine parts. In 2000, the U.S. Navy qualified such a coating for use on gears of air-conditioning units for its ships, saving $20 million in maintenance costs over 10 years. Such coatings can extend the lifetimes of moving parts in everything from power tools to industrial machinery.
- Nanoparticles are used increasingly in catalysis to boost chemical reactions. This reduces the quantity of catalytic materials necessary to produce desired results, saving money and reducing pollutants. Two big applications are in petroleum refining and in automotive catalytic converters.

VII. APPLICATIONS OF NANOTECHNOLOGY

Nanotechnology has a wide applications in various fields. It's usage in various fields is discussed independently below:

VIII. ELECTRONICS AND INFORMATION TECHNOLOGY

Nanotechnology is used in many computing, communications and other electronic applications to provide faster, smaller, and more portable systems that can manage and store larger and larger amounts of information. These continuously evolving applications include:

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- Nanoscale transistors that are faster, more powerful, and increasingly energy-efficient; soon your computer's entire memory may be stored on a single tiny chip.
- Displays for many new TVs, laptop computers, cell phones, digital cameras, and other devices incorporate nanostructured polymer films known as organic light-emitting diodes, or OLEDs. OLED screens offer brighter images in a flat format, as well as wider viewing angles, lighter weight, better picture density, lower power consumption, and longer lifetimes.

IX. Sustainable Energy

The difficulty of meeting the world's energy demand is compounded by the growing need to protect our environment. Many scientists are looking into ways to develop clean, affordable, and renewable energy sources, along with means to reduce energy consumption and lessen toxicity burdens on the environment.

[1]. Nanotechnology is improving the efficiency of fuel production from normal and low-grade raw petroleum materials through better catalysis, as well as fuel consumption efficiency in vehicles and power plants through higher-efficiency combustion and decreased friction.

[2]. An epoxy containing carbon nanotubes is being used to make windmill blades that are longer, stronger, and lighter-weight than other blades to increase the amount of electricity that windmills can generate.

[3]. Researchers are developing wires containing carbon nanotubes to have much lower resistance than the high-tension wires currently used in the electric grid and thus reduce transmission power loss.

[4]. To power mobile electronic devices, researchers are developing thin-film solar electric panels that can be fitted onto computer cases and flexible piezoelectric nanowires woven into clothing to generate usable energy on-the-go from light, friction, and/or body heat.

9.1 Nanobiosystems, Medical

Gold nanoparticles can be used to detect early-stage Alzheimer's diseases.

Multifunctional therapeutics where a nanoparticle serves as a platform to facilitate its specific targeting to cancer cells and delivery of a potent treatment, minimizing the risk to normal tissues.

Research enablers such as microfluidic chip-based nanolabs capable of monitoring and manipulating individual cells and nanoscale probes to track the movements of cells and individual molecules as they move about in their environments**.**

9.2 Future Transportation

In addition to contributing to building and maintaining lighter, smarter, more efficient, and "greener" vehicles, aircraft, and ships, nanotechnology offers various means to improve the transportation infrastructure:

- Nano-engineering of steel, concrete, asphalt, and other cementitious materials, and their recycled forms, offers great promise in terms of improving the performance, resiliency, and longevity of highway and transportation infrastructure components while reducing their cost. New systems may incorporate innovative capabilities into traditional infrastructure materials, such as the ability to generate or transmit energy.

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9.3 Security

Security has a wide field covering everything from the security of our borders to the security of our infrastructure to the security of our computer networks.

9.4 Advanced Computing

More powerful and smaller computers will encrypt our data and provide round-the-clock security.Quantum cryptography -- cryptography that utilizes the unique properties of quantum mechanics will provide unbreakable security for businesses, government, and military. Additionally, quantum computers provide better simulations to predict natural disasters and pattern recognition to make *biometrics* identification based on personal features such as face recognition possible.

9.5 Healthcare

Nanotechnology not only makes the world around us more secure but it also makes the world inside us more secure. With nanotechnology, what's beneath our skin is going to be more accessible to us than it has ever been before.

9.6 Diagnostics

Hospitals will benefit us more greatly from nanotechnology with faster, cheaper diagnostic equipments. The lab-on-a-chip waits to analyze the patient's ailments in an instant, providing point-of-care testing and drug application. Not only will nanotechnology make diagnostic tests better, but it will also make them more portable, providing time-sensitive diagnostics out in the field on ambulance.Newborn children will have their DNA quickly mapped, pointing out future potential problems, allowing us to curtail disease before it takes hold.

9.7 Novel Drugs

Nanotechnology will aid in the delivery of just the right amount of medicine to the exact spots of the body that need it most.Nanoshells, approximately 100nm in diameter, will float through the body, attaching only to cancer cells. When excited by a laser beam, the nanoshells will give off heat in effect, cooking the tumor and destroying it.

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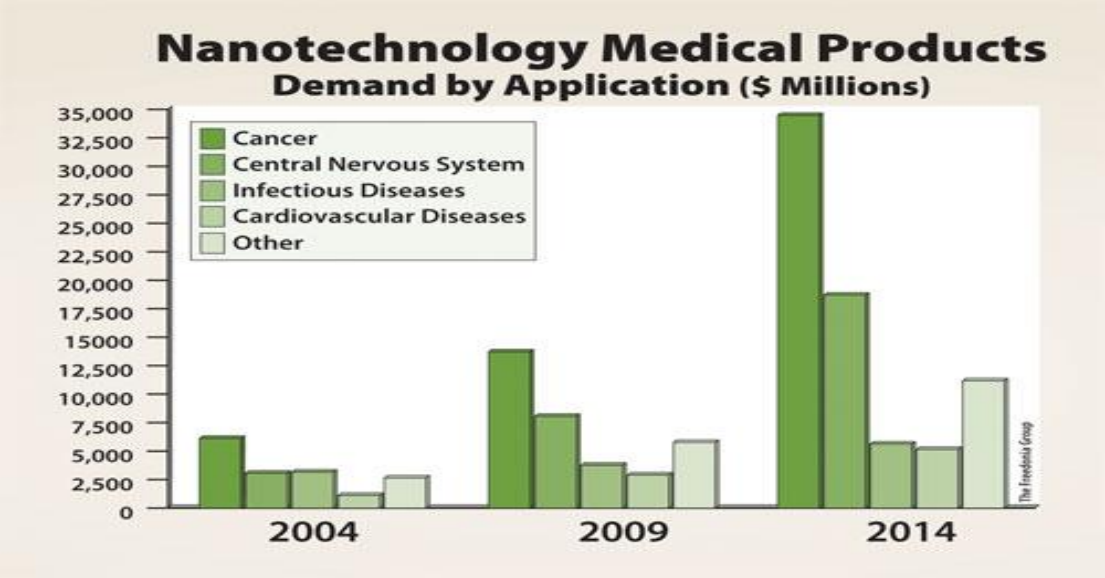

X. PROPOSED WORK

Nanotechnology provides us ease to access objects at a nanoscale which ultimately reduces the cost of the product and increasing its functionality. So, its applications should be increased and as more of the mass around the world gets its knowledge it ultimately results in progress.

XI. CONCLUSION

Nanotechnology is a brand new technology that has just began, it is a revolutionary science that will change all what we knew before. This technology keep us healthy as it has the ability to repair every damage we have in our body. It also provides the scientists with the ability to manipulate the combination of atoms in an object and ultimately turn it into lighter, stronger and more durable object than before, just by using carbon nanotubes which are hundred times stronger than steel and an addition to that they are very flexible. Nanotechnology, also gives us abundant energy because it can transform energy more effectivelyfor example windmills which are known to have the ability to transform wind energy into electrical energy, the 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.

XII. ACKNOWLEDGEMENT

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