Study of Nanotechnology in developed world

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ABSTRACT

Nanotechnology, despite its fantastic sounding name, is actually very practical for developing countries to make products better and cheaper. Technical innovations will increasingly shape developing economies and strengthen market robustness and build. This paper discusses the range of sciences currently covered by nanotechnology. It begins with a description of what nanotechnology is and how it relates to previous scientific advances. It then describes the most likely future development of different technologies in a variety of fields. The paper also reviews the government's current nanotechnology policy and makes some.

II. INTRODUCTION

A basic definition: Nanotechnology is the engineering of functional systems at the molecular scale. This covers both current work and concepts that are more advanced. In its original sense, 'nanotechnology' refers to the projected ability to construct items from the bottom up, using techniques and tools being developed today to make complete, high performance products.

Science and engineering are the primary drivers of global technological competition. Unifying science based on the unifying features of nature at the Nano scale provides a new foundation for knowledge, innovation, and integration of technology there is a longitudinal process of convergence and divergence in major areas of science and engineering. For example the convergence of sciences at macro scale was proposed during the Renaissance, and it was followed by narrow disciplinary specialization in science and engineering in the 18th-20th centuries. The convergence at the Nano scale reached its strength in about year 2000, and one may estimate a divergence of the Nano system architectures in the next decades. The figure1shows how the Nano world was reached and how technologies converged to nanoparticles

1. Applications under Development

Researchers are looking into the following applications of nanotechnology in space:

a. Using carbon nanotubes to make the cable needed for the space elevator, a system which could significantly reduce the cost of sending material into orbit.

b. Employing materials made from carbon nanotubes to reduce the weight of spaceships while retaining or even increasing the structural strength.

c. Producing thrusters for spacecraft that use MEMS devices to accelerate nanoparticles. This should reduce the weight and complexity of thruster systems used for interplanetary missions.

d. Using carbon nanotubes to build lightweight solar sails that use pressure of light from the sun reflecting on the mirror-like solar cell to propel a spacecraft. This solves the problem of having to lift enough fuel into orbit to power spacecraft during interplanetary missions.

e. Deploying a network of Nano sensors to search large areas of planets such as Mars for traces of water or other chemicals

2. . Grand Challenge:

Nano propellants - From the Test Tube to Practice Conventional cryogenic propellants present technical challenges in handling, storage and distribution. Cryogenic propellant tanks must be insulated often times resulting in the addition of parasitic weight to the vehicle. Long-term storage of cyropropellants also requires the use of cryo-coolers to limit boil-off which can also add weight to the vehicle. Compatibility and reactivity issues limit the materials that can be used for liquid oxygen storage and transfer. Currently available alternatives, such as hypergolic, are toxic and require special handling. Recent developments by a team of researchers at Penn State and Purdue Universities have demonstrated the feasibility of using Nano scale energetic materials, in this case slurry of Nano scale aluminum particles in ice (ALICE), as propellants. In this first demonstration, a small ALICE powered rocket was able to reach a height of 1300 feet. Significant technical challenges remain, however, before monopropellants such as these can be used in NASA missions. Nano scale metal particles are highly reactive materials. While this is desirable for propellants, it can create safety hazards. In addition, these particles are highly susceptible to surface oxidation which adds unneeded weight, as much as 20%, to the particles and reduces their specific thrust. Passivation techniques, such as functionalizing surface of the nanoparticles with organic groups can reduce susceptibility to oxidation and increase safety, however the proper functionalization chemistries must be identified that do not inhibit combustion. Manufacturing methods must be developed not only to scale up production of these materials, but also to develop ways to control the size and morphology of the nanoparticles and influence their burning behavior. Novel fabrication methods will enable the synthesis of core-shell nanoparticles with different metals in each layer of the nanoparticle which could be tailored to create particles with highly controlled burn rates and energies. Currently NASA is collaborating with other government agencies to mature this technology.

3. The Structure of Nanotechnology

Nanotechnology is distinguished by its interdisciplinary nature. For one thing, investigations at the Nano level are occurring in a variety of academic fields. More important, the most advanced research and product development increasingly requires knowledge of disciplines that, until now, operated largely independently. These areas include:

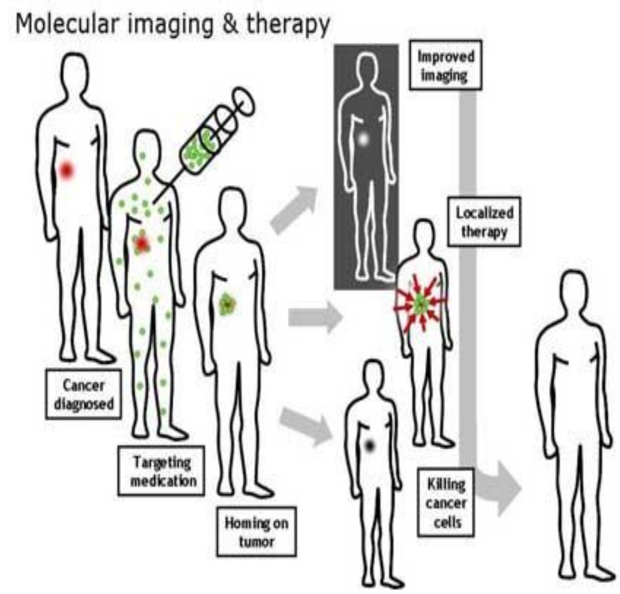
• **Physics —** the construction of specific molecules is governed by the physical forces between the individual atoms composing them. Nanotechnology will involve the continued design of novel molecules for specific purposes. However, the laws of physics will continue to govern which atoms will interact with each other and in what way. In addition, researchers need to understand how quantum physics affects the behavior of matter below a certain scale.

• **Chemistry —** The interaction of different molecules is governed by chemical forces. Nanotechnology will involve the controlled interaction of different molecules, often in solution. Understanding how different materials interact with each other is a crucial part of designing new nanomaterial's to achieve a given purpose.

• **Biology —** A major focus of nanotechnology is the creation of small devices capable of processing information and performing tasks on the Nano scale. The process by which information encoded in DNA is used to build proteins, which then go on to perform complex tasks including the

4 Foundations of cancers –

on novel Nano devices capable of one or more clinically important functions, including detecting cancer at its earliest stages, pinpointing its location within the body, delivering anticancer drugs specifically to malignant cells, and determining if these drugs are killing malignant cells. As these Nano devices are evaluated in clinical trials, researchers envision that nanotechnology will serve as multifunctional tools that will not only be used with any number of diagnostic and therapeutic agents, but will change the very foundations of cancer diagnosis, treatment,
and prevention.



Nanotechnology and cancer therapy:-

Nano scale devices have the potential to radically change cancer therapy for the better and to dramatically increase the number of highly effective therapeutic agents. Nano scale constructs, for example, should serve as customizable, targeted drug delivery vehicles capable of ferrying large doses of chemotherapeutic agents or therapeutic genes into malignant cells while sparing healthy cells, which would greatly reduce or eliminate the often unpalatable side effects that accompany many current cancer therapies. Already, research has shown that Nano scale delivery devices, such as dendrites (spherical, branched polymers), silica-coated micelles, ceramic nanoparticles, and cross-linked liposomes, can be targeted to cancer cells. This is done by attaching monoclonal antibodies or cell-surface receptor ligands that bind specifically to molecules found on the surfaces of cancer cells, such as the high-affinity foliate receptor and luteinizing hormone releasing hormone (LH-RH), or molecules unique to endothelial cells that become co-opted by malignant cells, such as the integrin a_vb_3. Once they reach their target, the nanoparticles are rapidly taken into cells. As efforts in proteomics and genomics uncover other molecules unique to cancer cells, targeted nanoparticles could become the method of choice for delivering anticancer drugs directly to tumor cells and their supporting endothelial cells.

Eventually, it should be possible to mix and match anticancer drugs with any one of a number of nanotechnology-based delivery vehicles and targeting agents, giving researchers the opportunity to fine-tune therapeutic properties without needing to discover new bioactive molecules.

The Progression of Nanotechnology:-

If it seems that nanotechnology has begun to blossom in the last ten years, this is largely due to the development of new instruments that allow researchers to observe and manipulate matter at the Nano level. Technologies such as scanning tunneling microscopy, magnetic force microscopy, and electron microscopy allow scientists to observe events at the atomic level. At the same time, economic pressures in the electronics industry have forced the development of new lithographic techniques that continue the steady reduction in feature size and cost. Just as Galileo's knowledge was limited by the technology of his day, until recently a lack of good instrumentation prevented scientists from gaining more knowledge of the Nano scale. As better instrumentation for observing, manipulating and measuring events at this scale are developed, further advances in our understanding and ability will occur. One leader in nanotechnology policy has identified four distinct generations in the development of nanotechnology products, to which we can add a possible fifth: [10]

(A) Passive Nanostructures (2000-2005)

During the first period products will take advantage of the passive properties of nanomaterial's, including nanotubes and monolayers. For example, titanium dioxide is often used in sunscreens because it absorbs and reflects ultraviolet light. When broken down into nanoparticles it becomes transparent to visible light, eliminating the white cream appearance associated with traditional sunscreens. Carbon nanotubes are much stronger than steel but only a fraction of the weight. Tennis rackets containing them promise to deliver greater stiffness without additional weight. As a third example, yarn that is coated with a monolayer of material can be woven into stain-resistant clothing. Each of these products takes advantage of the unique property of a material when it is manufactured at a Nano scale. However, in each case the nanomaterial itself remains static once it is encapsulated into the product.

(B) Active Nanostructures (2005-2010)

Active nanostructures change their state during use, responding in predicable ways to the environment around them. Nanoparticles might seek out cancer cells and then release an attached drug. A nanoelectromechancial device embedded into construction material could sense when the material is under strain and release an epoxy that repairs any rupture. Or a layer of nanomaterial might respond to the presence of sunlight by emitting an electrical charge to power an appliance. Products in this phase require a greater understanding of how the structure of a nanomaterial determines its properties and a corresponding ability to design unique materials. They also raise more advanced manufacturing and deployment challenges.

(C) Systems of Nano systems (2010-2015)

In this stage assemblies of Nano tools work together to achieve a final goal. A key challenge is to get the main components to work together within a network, possibly exchanging information in the process. Proteins or viruses might assemble small batteries. Nanostructures could self-assemble into a lattice on which bone or other tissues could grow. Smart dust strewn over an area could sense the presence of human beings and communicate their location. Small nanoelectromechancial devices could search out cancer cells and turn off their reproductive capacity. At this stage significant advancements in robotics, biotechnology, and new generation information technology will begin to appear in products.

(D) Molecular Nano systems (2015-2020)

This stage involves the intelligent design of molecular and atomic devices, leading to "unprecedented understanding and control over the basic building blocks of all natural and man-made things."[11] Although the line between this stage and the last blurs, what seems to distinguish products introduced here is that matter is crafted at the molecular and even atomic level to take advantage of the specific Nano scale properties of different elements. Research will occur on the interaction between light and matter, the machine-human interface, and atomic manipulation to design molecules. Among the examples that Dr. Rocco foresees are "multifunctional molecules, catalysts for synthesis and controlling of engineered nanostructures, subcellular interventions, and biomimetic for complex system dynamics and control."[12] Since the path from initial discovery to product application takes 10-12 years,[13] the initial scientific foundations for these technologies are already starting to emerge from laboratories.

III. CONCLUSION

Today, many of our nation's most creative scientists and engineers are finding new ways tonus nanotechnology to improve the world in which we live. These researchers envision a world in which new materials, designed at the atomic and molecular level, provide realistic, cost-effective methods for harnessing renewable energy sources and keeping our environment clean. They see doctors detecting disease at its earliest stages and treating illness such as cancer, heart disease, and diabetes with more effective and safer medicines. They picture new technologies for protecting both our military forces and civilians from conventional, biological, and chemical weapons. Although there are many research challenges ahead, nanotechnology already is producing a wide range of beneficial materials and pointing to breakthrough in many fields. It has opened scientific Inquiry to the level of molecules-and a world of new opportunities

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