A REVIEW ON NANO APPLICATIONS

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ABSTRACT

When a droplet of water lands on the lotus leaf, it beads up, rolls off the leaf surface without leaving a trace of water behind, and washes away any dirt along its way. This self-cleaning property fascinated scientists for a long time until recently, when scientists realized that this peculiar behaviour is due to the nanostructures present on the surface of the lotus leaf. They term this as super - hydrophobicity. These can be integrated in numerous parts of the building infrastructure. New developing nanostructured surfaces behave like the lotus leaf and stay dry when water lands on them. Such degree of water repellency exceeds even that of one of the most well-known hydrophobic materials, polytetrafluoroethylene (PTFE) or Teflon. Nanotechnology Imitates Nature.

Nano materials with unique properties such as: nanoparticles carbon nanotubes, fullerenes, quantum dots, quantum wires, nanofibers, and nanocomposites allow completely new applications to be found. Products containing engineered nanomaterials are already in the market. The range of commercial products available today is very broad, including metals, ceramics, polymers, smart textiles, cosmetics, sunscreens, electronics, paints and varnishes.

In addition to various industrial uses, great innovations are foreseen in information and communication technology, in biology and biotechnology, in medicine and medical technology, in metrology, etc. Significant applications of nanosciences and nanoengineering lie in the fields of pharmaceutics, cosmetics, processed food, chemical engineering, high-performance materials, electronics, precision mechanics, optics, energy production, and environmental sciences.

Nanotechnology is an emerging and dynamic field where over 50,000 nanotechnology articles have been published annually worldwide in recent years, and more than 2,500 patents are filed at major patent office such as the European Patent Office. This report presents the review of progress in selected nanotechology topics and some possible applications.

KEY WORDS: Carbon nanotubes (CNT), Single-walled carbon nanotubes (SWCNT), Double-walled carbon nanotubes (DWCNT), Multi-walled carbon nanotubes (MWCNT), Bioaccumulation, Aquatic toxicity.

INTRODUCTION

The word “nano” has a Greek origin meaning dwarf (small). Technically the prefix nano means “one billionth” or $10^{-9.}$ When nano prefix is used with science and technology, it becomes a new field of chemistry.First of all prof. Nario Taniguchi of Japan in 1974 used the word nanotechnology to describe the the extention of traditional silicon machining down into region smaller than one micron.

Materials when reduced down to 100nm show drastic changes in respect of physical, chemical, optical, mechanical and electrical properties. All these lead to exciting applications in Bioscience, Medical, Environmental sciences, Electronics, Security and Cosmetics. Nanomaterials are very light, mechanically strong, transparent and totally from bulk mterials.They also become very active and aggressive in chemical reactions.

The properties of materials are different at the nanoscale for two reasons:1. Nanoparticles have large surface to volume ratio than their bulk counterpart. This can make materials more chemically reactive and affect their strength and electrical properties. 2. Quantum effects can begin to dominant the behaviour of matter at the nanoscale affecting the optical, electrical and magnetic behaviour of materials.

Nanotechnology is one of the leading scientific fields today since it combines knowledge from the fields of Physics, Chemistry, Biology, Medicine, Informatics, and Engineering. It is an emerging technological field with great potential to lead in great breakthroughs that can be applied in real life. The application and use of nanomaterials are the economically most important parts of the nanotechnology nowadays and presumably in the near future.

RECENT APPLICATIONS OF NANOPARTICLES

1. Solar Cells: Renewable energy is increasingly viewed as critically important globally. Solar cells, or photovoltaics, convert the energy of the sun into electricity. In theory all parts of the visible spectrum from near-infrared to ultraviolet can be harnessed. The mainstay at present is the silicon solar cell which accounted for 90% of the market in 2004. However these are costly to manufacture and have limited efficiency (around 14% in most production modules, and up to 25% in the lab). The cost per unit of power is at least several fold higher using silicon solar cells than that derived from fossil fuel combustion.

2. Medical Applications: Nanomedicine is the process of diagnosing, treating, and preventing disease and traumatic injury, of relieving pain, and of preserving and improving human health, using molecular tools and molecular knowledge of the human body. Nanorobots would constitute any “smart” structure capable of actuation, sensing, signaling, information processing, intelligence, manipulation and swarm behavior at nano scale (10-9m).

For example bio nanorobots: Nanorobots designed by harnessing properties of biological materials (peptides, DNAs), their designs and functionalities. These are inspired not only by nature but machines too. Nanorobots could propose solutions at most of the nanomedicine problems.

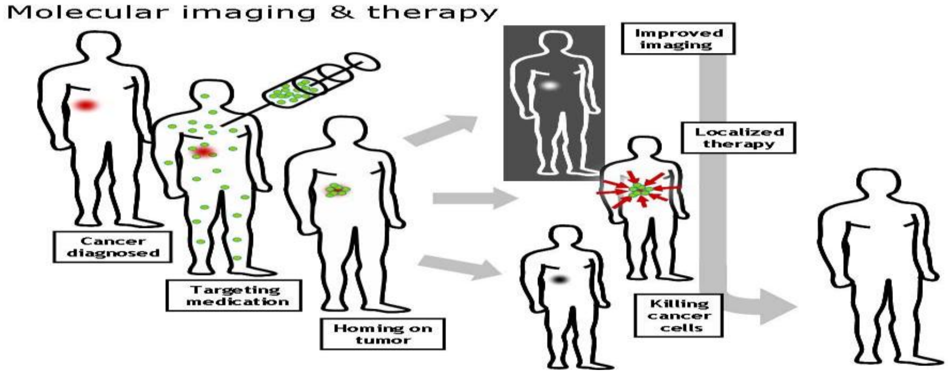

Figure.1.NanoRobotics – An Example: Ultra-Local Drug Delivery

3. Electronics: Carbon nanomaterials such as one-dimensional (1D) carbon nanotubes and two-dimensional (2D) graphene have emerged as promising options due to their superior electrical properties which allow for fabrication of faster and more power-efficient electronics. At the same time their high surface to volume ratio combined with their excellent mechanical properties has rendered them a robust and highly sensitive building block for nanosensors.

For example: Carbon nanotube electronics : When a layer of graphene is rolled into a tube, a single-walled carbon nanotube (SWNT) is formed. Consequently, SWNTs inherit the attractive electronic properties of graphene but their cylindrical structure makes them a more readily available option for forming the channel in field-effect transistors. Such transistors possess an electron mobility superior to their silicon-based counterpart and allow for larger current densities while dissipating the heat generated from their operation more efficiently. During the last decade, carbon nanotube-based devices have advanced beyond single transistors to include more complex systems such as logic gates and radio-frequency components. They can be used as lubricants or glidants in tablet manufacturing due to nanosize and sliding nature of graphite layers bound with van der
waals forces.

4. **Single Electron Transisor:** In contrast to common transistors, where the switching action requires thousands of electrons, a single electron transistor needs only one electron to change from the insulating to the conducting state. Such transistors can potentially deliver very high device density and power efficiency with remarkable operational speed. In order to implement single electron transistors, extremely small metallic islands with sub-100 nm dimensions have to be fabricated. These islands, which are referred to as quantum dots, can be fabricated by employing processes made available by the advances in nanotechnology.

5.**Nano- and micromotors**: Nano and micromotors are nano- and microscale devices, respectively, designed to perform selected mechanical movements (e.g., rotation, rolling, shuttling, delivery, contraction, and collective behavior) in response to specific stimuli. They are built from a few nano- and microscale components, each of which can be biologically or chemically functionalized, and operate using some type of energy input. In fact, these devices are princip ally characterized according to the type of energy input that they use, as their operating mechanism is strongly related to the energy source, which can be fuel (natural or synthetic), or a physical source (e.g., light, magnetic fields, electric fields, or ultrasonic acoustic waves). Nano- and micromotors are often mimics of natural biological motors.

SUMMARY AND CONCLUSION

Nanotechnology is an emerging technology with applications in several scientific and research fields, such as information and communication technology, electronics, energy, biology, medical technology, etc. Novel nano- and biomaterials, and nanodevices are fabricated and controlled by nanotechnology tools and techniques, which investigate and tune the properties, responses and functions of living and non-living matter, at sizes below 100 nm.

Nanotechnology is a science with huge potential and great expectations. The daily announcements of new discoveries and breakthroughs are going to influence all aspects of human society. In the last few years there was a rapid progress in the fabrication and processing of nanostructures. As a result nanophase materials and applications are already in the market and a large volume of new applications is expected over the next several years.

However, the development and commercialization of products containing nanomaterials raises many of the same issues as with introduction of any new technology, including concerns about the toxicity and environmental impact of nanomaterial exposures. Despite the extensive research of the last decade the literature on toxicological risks of the application of nanotechnology in medical technology is scarce.

The nanoscale precision and the detailed investigation that these nanometrology techniques offer, give them an enormous potential for even more advanced applications for the improvement of the quality of research and of the everyday life.

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