Nanobiology applications and limitations: an Overview

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Abstract: Nanobiology is the field that deal with biology at the nano range of scale. Nanobiology has got various advantages in medicine and biotechnology. It is used in the manufacture of scratch proof eye-glasses, crack- resistant paints, anti-graffiti coatings for walls, transparent sunscreens, stain-repellent fabrics. Nano- science and technology involve the study of structures from one to one hundred nanometres. It is believed that the influence of nanotechnology will be felt across a broad spectrum of fields from computing and information technology, health care and biotechnology, environment, energy and transportation to space exploration. Conventional lithography techniques generate structures at nanoscale using a top-down approach.

Key Words: Nanobiology, Biomimetics, Nanotubes, Cell manipulation

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Introduction

Nanobiology can be treated as bionanotechnology, the application of biology and biomolecules into technological applications at the nano-scale. These directions will be extensively described in this book. Yet, as an introduction, we would like to mention the use of biomolecules for the fabrication of metallic structures at the nano-scale. Such structures can serve in future computers or other devices that may have no direct association with biology. Yet, the biology may provide tools that are not currently available by any other means. This was illustrated by the practice of molecular lithography in which protein molecules of few nano-meters served as a resist for the fabrication of gold wires on DNA molecules. Other directions may include the formation of novel materials of unique rigidity, surface chemistry, or other physicochemical properties that may prove useful in the automobile or space industries or simply in consumer goods. It is worth noticing that the ability of biological molecules to template the formation of inorganic materials at the nano-scale has been exploited since Egyptian antiquity, with the development of lead-based hair dyes. Human hair is an example of material that is organized from simple molecular building blocks from the nano- to the macro-scale [1]. The recipe for hair blackening consisted in applying lead oxide with calcium hydroxide and a small amount of water to form a paste. An experiment reproduced in a modern laboratory demonstrated that hair blackening is due to the release of sulfur from the cysteine amino acids in hair and the subsequent precipitation of lead sulfide nanocrystals of average size of 5nm. What is remarkable is that the deposition of these nanocrystals is dictated by the nano-scale order and supramolecular organization of keratins, the molecular building block of human hair.The second direction that is quite distinct is the application of technolo-gies that were developed at the nano-scale for the advancement of biological processes, such as tissue engineering or diagnostics[2]. These nano-scale structures may not include any biological molecules of nano-scale orderas they could completely utilize silicon-based structures or carbon nanostructures. Such an application could actually revolutionize the field of biotechnology by allowing the early diagnosis of disease, the online monitoring of therapeu-tic procedures, and the formation of tissue in the test tubes.

Nanobiotechnology or Bionanotechnology

Nano-biotechnology is defined as a field that uses nanoscale principles and techniques to understand and transform biosystems. The field of nanobiotechnology is best described as helping modern medicine in overcoming barriers in effective treatment and diagnostic of disease. Small magnetic nanoparticles have opened a new window of diagnostic and treatment of cancer, these small magnetic nanoparticles can be used as contrast agent for Magnetic Resonance Imaging(MRI) and for hyperthermia treatment of cancer. Non-Cancerous cells are less susceptible to high temperature so hyperthermia treatment does not affect non-cancerous cells. Nanotechnology can take this to a new level with nanoprobes that target the proteins more accurately, dispersing gold, dyes and perhaps both[3]. This may sound like science fiction to some, with some curiosity about the practical implications. However, the actual benefit of these new approaches is clear with the next development. One of the most interesting uses of nanobiology for many that are new to the science is cancer therapy. There are many new developments in screening and treatment options for colon and prostate cancer that includes nanotechnology. The aim is to enhance the potential of photodynamic cancer therapy by highlighting the cells to be then targeted by the lasers. The more accurate the detection rate, the more effective the treatment. Nanotechnology can increase the chances of dyes and gold particles reaching the cancer cell. This means greater detection rates that make it easy to catch the problem and treat it faster. This could help to reduce prostate and colon cancer mortality rates. A recent discovery showed that nanoparticle tissue engineering could create a new tissue surface that would allow the new “bone” and tissues to fuse [4]. This surface could also allow for a porous structure that would allow for nutrients to pass through. With further development in this area, this could have important implications in transplants and plastic surgery. Color coding is an important part of genetics when determining a sequence. It provides a visual map of genes and proteins that makes it much easier to identify sequences, defects, and anomalies. The problem with the old system of dyes is that there were only so many colors to use in a series. The development of nanotechnology and colored particles has changed that. This new system uses a series of the compound semiconductor to manipulate more freely and combine to form new patterns and colors. The current state of nanotechnology means that our current understanding can take developers into many different areas.

Biomimetics

Biomimetics, or the study of biological systems to inspire human-engineered systems, is a unique area of study that relies on natural systems for design concepts. The number of possible research areas within biomimetics is large, since this field seeks to broadly inspire technological and engineering advances from biological themes. A general example of biomimetics is the use of the lotus plant as inspiration for water-repellent

technology. At the nanoscale, the leaves of the lotus plant have regularly-spaced features that cause water droplets to roll off of the leaf surface, without spreading out and "wetting" the leaf. This natural water-repellency has been mimicked by constructing similar nanostructures out of polymeric materials. These bio-inspired nanostructures accurately mimic the properties of the lotus leaf, creating a non-wettable, water-repellent surface [5].

The Future of Nanobiology

For many, nanobiology is a wonderful window into the future of biomechanics and medicine. The nature of the science and the minute details mean that this seems like a technology that should be out of reach. The truth is that the models described above are all functional and in continued development. This means that there is plenty of room for future ventures with drug delivery system and cell targeting to make them even more efficient and effective. Also, there are hopes that these focused devices could become multi-functional with different processes and medical benefits. The world of nanotechnology in medicine is now open, and there is a lot more to learn [6].

Safety Concerns of Nanotechnology:

There are several safety concerns in the automotive sector relating to nanotechnology. Nanoparticles as fillers in tyres can improve adhesion to the road, reducing the stopping distance in wet conditions. The stiffness of the car body can be improved by use of nanoparticle-strengthened steels. New sol-gel deposition methods make it possible to apply, economically, nanometre thick antireflection layers of silicon dioxide or other materials onto displays or panes. Ultra-thin transparent layers on a silver base can be used for heatable, and therefore mist and ice-free, window panes. Transparent and light materials could substitute car body parts that reduce all-round vision at the moment. Nanotechnology can be applied in the production, processing, safety and packaging of food. It is possible that nanotechnology will allow the manipulation of the molecular forms of food to provide more capability, lower costs and greater sustainability than at present. A nano composite coating process should improve food packaging by placing anti-microbial agents directly on the surface of the coated film and could increase or decrease gas permeability as required for different products. They can also improve the mechanical and heat-resistance properties and lower the oxygen transmission rate. It should also be possible to apply nanotechnology to the detection of chemical and biological substances for sensing biochemical changes in foods, extending to the whole food chain in the future. Nanomaterials are also being used in biology and medicine in a wide variety of ways, including the direct application of products into patients [7]. Examples include products for drug delivery and gene therapy, the separation and purification of biological molecules and cells, fluorescent biological labels, imaging contrast agents, tissue engineering, DNA probes and nanoscale biochips, and microsurgical technology. Inhaled nanoparticles may represent a potential health risk. Aerosols in workplace environments may be derived from a wide variety of sources, depending on the type of activity and processes taking place.

Conclusion

From this review of research topic within nanobiology, it is clear that nanobiology is a combination of biological, chemical, physical and engineering research. Nano- biology focuses on using our understanding of nanotechnology to advance our research capabilities and approach biology from a unique, nanoscale perspective. This promises to develop new techniques, provide new understanding, and as in any scientific field, yield new and ever more complicated questions to be answered. By approaching biology from the nanoscale, nanotechnology from a biological perspective, we hope to gain unique insights into how biological systems function and how we can develop new and better bio-inspired technologies. This exciting frontier promises to develop new techniques, provide new understanding, and as in any scientific field, yield new and ever more complicated questions to be answered.

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