International Journal of Research Publication and Reviews

Journal homepage: www.ijrpr.com ISSN 2582-7421

A Review: Nano Science as Opportunities in Health & Research Area.

S.D. Charpe[1], P.P. Raut[2], R.V. Bhagwat[3], Vijay U. Rahangdale[4]*

[1]*Department of Physics, J.D. Patil Sangludkar Mahavidyalaya, Daryapur Dist. Amravati, Maharashtra-444803, India*
[2]*Research Scholar, Department of Physics, Vidya Bharti Mahavidyalaya, Amravati, Maharashtra-444602 India*
Jagat Arts, Commerce and I.H.P. Science College, Goregaon, Dist. Gondia. Maharashtra- 441801 India
**Corresponding Author: - sushildeo86@gmail.com*
DOI: https://doi.org/10.55248/gengpi.4.1023.102838

A B S T R A C T

Devolvement's of Science in 20th century make human life pleased with prospective Health. Innovation of "Nano" Science change structure of many materials from micro size to nano size that inspires scientist's community to manipulate many materials into nano size (bio medicine) which gives remedies for improvable diseases and chronic diseases. In commercial approach because of nano science cost of many medicines become low which improve the common man wealth ultimately subsequent in nation prosperity. This satisfies the catch phrase 'Health is Wealth'.

Keywords: Science; Nanotechnology; Nanomaterials; Healthcare.

1. Introduction

Technological innovations such as Science aim to enrich human life. However, nanotechnology presents a unique technical challenge in that a disparity of nine orders of magnitude separates the length scales of a human (a meter) and a nanometer. Ultimately, this goal needs to be achieved through the development of a definitive pathway that fuses existing technology with future technology to link the nanoscale with human life. Taking advantage of those interesting properties of nanoscale particles will require the successful manipulation of their position and properties. For example, a self-assembling biological system could be employed in a bottom-up fabrication scheme. The fusion of biology with nanotechnology will not only result in technological innovation but will also encourage future research into natural biological nano systems.

Once an academic curiosity, nanotechnology has sweeping implications for many electronic, optical, magnetic, catalytic, and medical-therapeutic applications. Nanomaterials are being used to produce composite materials with improved electro conductivity and catalytic activity, hardness, scratch resistance, and self-cleaning capabilities. They are being exploited to improve the performance of gas sensors and other devices, the way drugs reach targets in the human body, and the aesthetic appeal and efficiency of consumer products.

In this review the necessary strategies for realizing the ultimate goal of nanotechnology to benefit the human condition. Fundamental studies in the nano sciences have provided the building blocks on which nanotechnology will drive the creation of novel devices with applications in energetic, electronics, materials, medicine, and beyond. These systems will address the differences between being integration or fusion-based by possessing embedded intelligence through a series of nanoscale sensors and actuators. Nanotechnology achievement of this magnitude would serve dual roles. First, nanotechnology would be cemented as the visionary industry for the next millennium. Second, the true benefits for humankind enabled by the maturation of this technology will have been realized. The example of coordinated smart dust activity provides a promising demonstration of basic emergent behavior.

The extreme surface-to-volume ratio of nanoparticles is a key attribute that accounts for their range of superior performance characteristics. As the functional advantages of ultra-small particles continue to be deciphered, and processes are perfected to make and manipulate then, there seems to be no limit to what nano-materials can do.

2. Role of Nano Science Technology in Health Care Area

Nanotechnology in Life care

Nanotechnology offers new solutions for the transformation of bio systems and provides a broad technological platform for applications in industry; such applications include bio-processing, molecular medicine (detection and treatment of illnesses, body part replacement, regenerative medicine, nanoscale surgery, synthesis and targeted delivery of drugs), environmental improvement (mitigation of pollution and ecotoxicology), improving food and agricultural systems (enhancing agricultural output, new food products, food conservation), and improving human performance (enhancing sensorial capacity, connecting brain and mind, integrating neural systems with nano electronics and nano-structured materials). Nanotechnology will also serve as a technological platform for new developments in biotechnology; for example, biochips, “green” manufacturing (bio compatibility and bio complexity aspects), sensors for astronauts and soldiers, bio fluidics for handling DNA and other molecules, in vitro fertilization for livestock, nano filtration, bio-processing by design, and traceability of genetically modified foods [1].

Figure 1: Health Care

2.1. Nanoparticles for Drug Delivery

Nanoparticle-based delivery vehicles improve drug efficacy by modulating drug, kinetics and bio distribution. Small-molecule drugs are rapidly eliminated from the circulation by the kidneys. Injectable nanoparticle delivery vehicles, typically ranging from 5nm to 200nm in size, substantially increase circulation (particles >5nm avoid kidney clearance) while minimizing removal by cells that police the blood for foreign particles (macrophages have less propensity for particles <200nm in size). Oral delivery is currently the most preferred method of drug administration because of its cost effectiveness and ease of use.

The market for oral drug-delivery systems has been growing at a rate of 8.6 percent per year since 2000. A major area of research in oral delivery is in delivery materials for protein drugs. Because particle permeability across the intestinal wall is inversely proportional to size, nanoparticles used for oral delivery offer obvious advantages. The interest in nanoparticle-based drug delivery for other administration routes is also growing. The following sections focus on polymer, lipid, and inorganic or metallic nanoparticles that are <500nm in size. For example, a cyclodextrin-based polymer developed at Insert Therapeutics increases the solubility of camptothecin, an insoluble chemotherapy drug, by three orders of magnitude.[2]

2.2. Inorganic and Metallic Nanoparticles

Delivery of drugs using new inorganic and metallic nano-sized vector is still in the proof-of-concept of stage. One unique approach originates from C-60, a soccer ball shaped fullerene [2].Another interesting approach is to use magnetic nanoparticles to carry chemotherapeutic drugs to cancer sites directed by an external magnetic field.

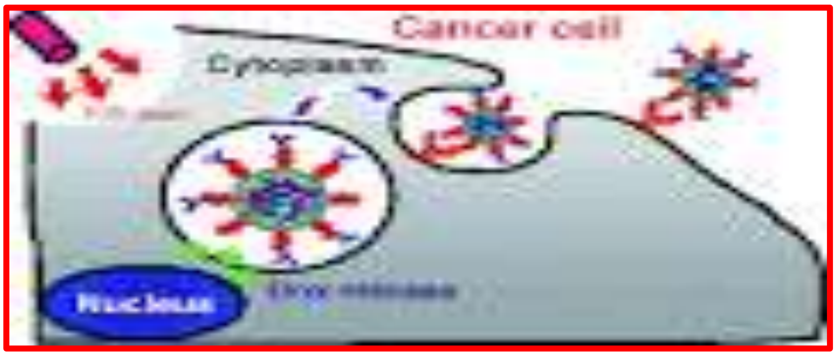

Figure 2: Inorganic and Metallic Nanoparticles as Drug Deliver

Very recently, other metal nanoparticles have been investigated as therapeutics and drug-delivery systems. An example from Dr. Naomi Halas's research group (Rice University) is the nano shell, a new type of nanoparticle composed of a dielectric silica core coated with an ultrathin gold layer [3]. Once the nano shells penetrate tumor tissues, they can be activated for thermal therapy by taking advantage of their ability to convert absorbed energy from the near-infrared region to heat.

2.3. Nano-porous Membranes

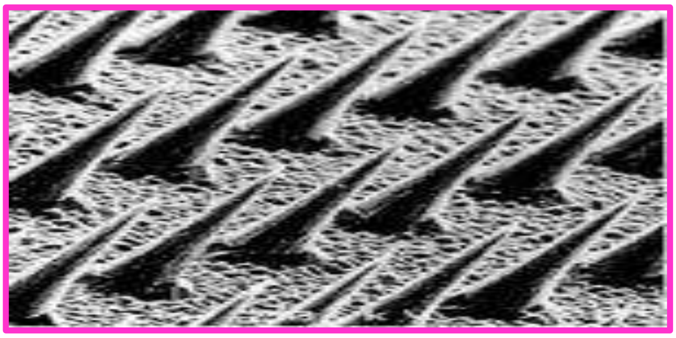

Figure 3: Solid silicon micro needles with heights ~150nm can be applied painlessly to enhance trans dermal drug delivery.

Nano-porous membranes are micro fabricated with well-defined pores (diameters in the tens of nanometers). The membranes can be used to deliver small-molecule, peptide, or protein drugs figure 3. One application under investigation involves encapsulation of pancreatic islet cells for insulin delivery. The reproducible and uniform pore size precisely controls the material exchange across nano-porous membranes: Nutrients for the cells and secreted insulin can pass through the pores, but proteins and cells from the immune system that may attack the implanted islet cells are restricted from entering the bio-capsules due to their size.

A pilot human trial revealed that the micro needle arrays are indeed applied painlessly [4]. Trans dermal micro needle delivery was quickly adopted by the pharmaceutical and drug-delivery industries; several companies are currently developing this technology for trans dermal drug administration. As this technology matures, it has the potential to quickly surpass the market currently occupied by traditional patch formulations.

2.4. Automated diagnosis

Medicine has already become accustomed to depending on heavy computations in the various topographies that are now routine in large hospitals. Diagnosis is essentially a problem of pattern recognition: an object (in this case, the disease) must be inferred from a collection of features. Although there have already been attempts to ease the work of the physician by encapsulating his or her knowledge in an expert system that makes use of the physician's regular observations, significant progress is anticipated when measurements from numerous implanted biosensors are input to the inference engine. This is an example of indirect nanotechnology: the practical feasibility depends on the availability of extremely powerful processors, based on chips having the very high degree of integration enabled by nanoscale components on the chips [5].

2.4. Biomedical devices

Figure 4: Biomedical devices

The flagship nano-medical system (rather than device) is the "nano-bot", an autonomous robot envisaged to be about the size of a bacterium (i.e., about one micrometer in diameter), and containing many nano devices (an energy source, a means of propulsion, an information processor, environmental sensors, and so forth). When engineering such devices it is important to note the environment in which they must operate: viscous (highly dissipative), dominated by friction and fluctuations (Brownian motion), and in which inertia plays a negligible role. This is in contrast to the familiar macroscopic mechanisms that follow Newton's laws: for the nano-bot, force is not given by the product of mass and acceleration, but by the product of the coefficient of friction and its velocity, together with superimposed random fluctuations. Any self-propelling nano-bot are therefore likely to resemble a motile bacterium rather than a device equipped with nanoscale oars or paddles [5].

2.5. Biochips

Drug release from IDD devices is not constant, and "burst" effects are still observed. In addition, drug release cannot be controlled after implantation of IDD devices. Biochips have been developed to precisely control the amount of drug released. Biochips are usually fabricated using silicon and contain a number of mini-wells with precisely controlled sizes, each capable of holding a few hundred nano liters. These mini-wells are loaded with drugs and are covered with caps of thin metal foils (usually gold) that are connected to the wires on the face of the chips [6].

When electrical signal is applied, the current dissolves the metal covers and releases the drug. Biochips can be implanted beneath the skin or into more specific areas such as the spinal cord or brain. The electronics package outside the chips receives a radiofrequency instruction through a built-in antenna to order a microprocessor to control the melting of metal foils. Microchips, Inc. is one of the key companies developing this technology. Preclinical studies in animals using biochips developed by Microchips, Inc., have shown good biocompatibility without significant side effects. Once successfully developed, the biochip-based drug-delivery technology will allow for precisely controlled drug administration to patients.

Figure 6: Biochips

3. Advantage of Nanotechnology in Pharmacy and Future Trends in Drug Delivery

Many other promising drugs never make it to clinical trials because of inherent pharmacological drawbacks. Low-molecular-weight drugs, such as most chemotherapy drugs, are usually insoluble and highly toxic. Protein and nucleic acid drugs usually have poor stability in physiological conditions. It is therefore essential for these drugs to be protected en route to their target disease sites in the body. Drug-delivery systems may rescue potential drug candidates by increasing solubility and stability.

Drug-delivery technologies are developed to improve the safety and efficacy of drugs, to ensure better patient compliance, and to improve the shelf life and stability of therapeutic products. Controlled drug release involves the combination of a biocompatible material or device with a drug to be delivered in a way that the drug can be delivered to and released at diseased sites in a designed manner.

The major routes of drug administration are oral, inhalation, injection, and transdermal delivery. The most well-known route is oral drug delivery, which accounted for about 50 percent of the market as of 2003. The other routes of administration inhalation, transdermal, injection and implantation, and nasal delivery account for the remaining market share at 19 percent, 12 percent, 10 percent, and 7 percent, respectively. In the past 30 years, the field of drug deliveryhas been undergoing rapid development and has attracted attention from both academia and pharmaceutical industries. According to a recent report, the U.S. market alone for drug delivery is estimated at $43.7 billion in 2003 and is expected to grow more than 11 percent annually in the next five years [7].

Nanotechnology has played a large role in advancing the drug-delivery field by enhancing existing areas of small-molecule and protein delivery and by opening doors for delivery of new families of nucleic acid-based drugs. The ability to control the properties of nanoscale materials will continue to impact the pharmaceutical field by providing new technologies for improved drug delivery. We are optimistic that these developments will lead to delivery vehicles with high target specificity and with the ability to precisely control drug release.

4. Commercial Areas for Nano Science Technology

High surface-to-volume catalysts, which promote chemical reactions more efficiently, and selectively**;** ceramics, lighter-weight alloys, metal oxides and other metallic compound in coatings, paints, plastics, fillers, and food-packaging applications. Polymer–composite materials, including tires, with improved mechanical properties transparent composite materials, such as sunscreens containing nano size titanium dioxide and zinc oxide particles use in fuel cells, battery electrodes, communications applications, photo- graphic film developing, and gas sensors**.** nano-bar codes tips for scanning probe microscopes.

5. Ethical, Legal, and Societal Implications

In addition to the lingering environmental, health, and safety questions associated with nanotechnology, a wide-ranging array of ethical, legal, and societal questions also arise when on considers the wide-ranging nature of the many nanotechnology applications currently under development.

6. Conclusion

Science has vital role in human day-to day life. In 1980’s innovations of “Nano Science” in form of new arising technology, make enormous change in human life. This science technology made human health away from diseases and give remedies for improvable diseases and chronic diseases. Ultimately Science makes human life exultant.

REFERENCES

[1] Biomedical Nanotechnology; Neelina H. Malsch, CRC Press Taylor & Francis Group ISBN 0-8247-2579-4, (2005).

[2] Nanotechnology: Science, Innovation, and Opportunity; Lynn E. Foster, ISBN-13: 978-0-13-192756-8, (2005).

[3] R. D. Bolskar, A. F. Benedetto, L. O. Husebo,*etal*. ,"First soluble M@C-60 derivatives 3provide enhanced access to metallofullerenes and permit in vivo evaluation of Gd@C-60[C(COOH)(2)](10) as a MRI contrast agent," Journal of the American Chemical Society125: pp.54715478,(2003).

[4] J. L. West and N. J. Halas, "Engineered nanomaterials for biophotonics applications: Improving sensing, imaging, and therapeutics," Annual Review of Biomedical Engineering **No. 5**,pp.285297,(2003).

[5] M. R. Prausnitz, "Microneedles for transdermal drug delivery," Advanced Drug Delivery Reviews 56, **No. 5**, 581587,(2004).

[6] Nanotechnology; Jeremy Ramsden, ISBN 978-87-7681-418, **Vol.2**,(2009).

[7] J. Santini, M. Cima, and R. Langer, "A Controlled-release Microchip," Nature 397, pp.335, (1999).

[8] O. Gorka, M. R. Hernández, A. Rodríguez-Gascón, A. Domínguez-Gil, and J. L. Pedraz, "Drug delivery in biotechnology: Present and future," Current Opinion in Biotechnology 14 , pp. 659664, (2003).