

# Nanotechnology: An Effective and Useful Technology For The Future



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## Opinion

Nanotechnology has been emerged as a new field to measure, design and manipulate at the atomic, molecular and supramolecular levels in an attempt to create, understand and use material structures, devices and systems of about 1-100 nm in diameter with fundamentally new properties and functions such as solubility, diffusivity, blood circulation half-life, drug release characteristics and immunogenicity attributable to their small structures. Nature has already accomplished this in living systems and in the environment. In the last two decades a number of nanoparticles based therapeutic and diagnostic agents have been developed for the treatment of cancer, diabetes, pain, asthma, allergy, infections and so on. These nanoscale structures are capable enough for effective and/or more convenient routes of administration, lower therapeutic toxicity, extend the product half-life and lastly reduce the health care cost.

Nanoparticles also allow targeted delivery and controlled release. In the field of diagnostics, nanoparticles allow detection at molecular level to identify abnormalities such as fragment of viruses, precancerous cells, and disease markers that cannot be detected with traditional diagnostics. Nanoparticle based imaging contrast agent have also been shown to improve the sensitivity and specificity of MRI. Nanoparticle based drug delivery improves the solubility of poorly water-soluble drugs and prolongs half-life of drugs in the circulation by reducing immunogenicity. It also helps to release drug at a controlled rate or in an environmentally responsive manner which in turn reduces the frequency of administration and minimize the systemic side effects. The National Nanotechnology Initiative, created by President Bill Clinton in 2000, has called it "the next industrial revolution". The total value of all products worldwide that incorporated

nanotechnology was \$13 billion in 2004, grew to \$32 billion in 2005 and to \$ 50 billion in 2006 and it will reach to \$ 3 trillion globally by 2014. Nanotechnology, a relatively new field has the potential to revolutionize the agriculture, veterinary and medical science throughout the world. It refers to the interaction of cellular and molecular components and engineered materials (clusters of atoms, molecules, and molecular fragments). It encompasses all areas of research where the characteristic dimensions are within the range of 1-100 nm (nm or  $10^{-9}$  metre) which is the scale of dimension for most components of biomolecular complexes. One nm is 180,000th width of a human hair. The size of some biological materials are bacteria: 1000 -10,000 nm, virus: 20-100 nm, protein: 5-50 nm, DNA (width): 2 nm and atom: 0.1 nm. The wavelength of the visible light is between 400 nm and 700 nm.

The understanding of the principles of nanotechnology will have great impact on research leading to new discoveries. The progress in research on nanotechnology will not only address challenges in the field of engineering but also in the field of human and animal health. The term nano is derived from the Greek word 'dwarf'. A nanometer is one billionth of a meter or one millionth of a millimeter. Thousand nanometers (nm) make one micrometer ( $\mu\text{m}$ ), 1000 micrometers make one millimeter (mm) and 1000 millimeter make one meter.

Nanotechnology, an interesting and novel technology has the potential to revolutionize not only medical and veterinary field but also agriculture and food systems. It has the capability to diagnose the disease well before the individuals show the symptoms by integrated sensing, monitoring, and controlling systems. Nanotechnology will improve the technical skill and expertise to a new height in improving not only the health care

of pets but also the other animals as well. It also improves the quality of life and standard of living of human being that will minimize the health care cost to a large extent. It is believed that nanotechnology is empowering biologists with tools to give new insights into biochemical phenomenon with better control and faster turnaround time. However, there are few fundamental questions about these materials that must be answered if nanotechnology is employed to have a major impact in various

field. The field of nanotechnology is still in its infancy and lot of exercise has to be carried out before being used in a routine and regular manner. The interdisciplinary nature of Nanotechnology is beginning to bring together the creative minds of scientist, engineers and biologists to work at the cellular and molecular levels not only to understand the physical and biological world but also to achieve the significant benefit in the field of diagnosis, treatment, drug delivery and health care of humans and animals.



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