**Recent Trends in Fascinating Use of Nanotechnology**

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**Abstract:**

The adjustable optical, structural, and surface characteristics of the nanoscopic administration magnify the quality of integrated nanodevices and sensors. These are later used in optoelectronics, biomedicines, and catalysis. The use of nanomaterials for making nano-biosensors and various other organic and inorganic functional nanomaterials is quite encouraging. They have outstanding electronic and surface-to-volume reactivity. It has possible appeal for altering the surface, structural and physicochemical characteristics of nano-linked meta-materials. Nanoparticulate technology is of specific use in developing a new generation of more efficacious cancer therapies competent of controlling number of biological, biophysical and biomedical barriers that the body stages against a standard intervention. Their various supplications include metal and metal-oxides-based nanoparticles, wires, clusters, and nano sheets as carbon nano tubes. More latterly, hybrid nano materials are being expanded to regulate sensing working functions in the area of nano medicine and the pharmaceutical company. The incorporation of nanotechnology in food packaging systems has shown promise for increasing the quality and shelf life of food.

**Keywords:** Nanomaterials,Applications of Nanotechnology

**Introduction:**

Nano compounds are prepared in various shapes and sizes which include 1D, 2D and 3D structures (inorganic, organic, and dendrimers). The particles can be framed in the form of particles, sheets, rods, and wires depend on their dimensionally restricted electronic properties. The surface sites and band structures of such sketched nanostructures have been synthesized through various techniques and processed for large number of uses in different areas of medicine. Two-dimensional carbon nanomaterials, such as CNTs, graphene, or quantum dots (TiO2, ZnO, CuO, etc.), and semiconductors are also handed down to intensify the quality and safety of medicinal therapies.

Nanotechnology have grown-up into maximum active, vital, and enlarging fields of research for progressing small particles with multidimensional force in the region of nutrition, agriculture, cosmetics, paints and coatings, personal care products, catalysts, energy production, lubricants, security printing, molecular computing, structural materials, drug delivery, medical therapeutics, pharmaceuticals, and diagnostics [[1](#_bookmark9)]. The confound nano size of these materials provides a large surface-area-to-volume ratio and, correspondingly, more surface atoms compared to their micro scale counterparts. This increases the properties of materials with minor defects on their surfaces [[2](#_bookmark10)]. Moreover, nanomaterials have been expanded as nano composites, which are bring about solid materials that result when two or more different constituent materials with different physical and chemical properties are combined to create new substances [[3](#_bookmark11)]. Nanocomposites are hybrid materials consisting of mixtures of polymers and inorganic solids (such as clays and oxides) at the nanometer scale. The remarkably complicated structure of nanocomposites, in which one phase (such as nanoparticles (NPs) and nano-tubes) has a nanoscale analysis, having things that are dominating to those of micro composites in a congregate structure [[4](#_bookmark12)].

The concept of nanotechnology was introduced in 1959 by Richard Feynman and the term “nanotechnology” was later coined by Norio Taniguchi in 1974. Nanotechnology mainly include of fabrication, characterization and administration of nanorange(<100nm)molecules. The application of nanotechnology in polymers involve the design, manufacturing, processing and application of polymer materials filled with nano-particles and/order vice nano range. [5]

# Discussion:

## **Important Nanoparticles**

The vast prospective of this promising interpose has gained attention of researchers from multi-disciplinary are as i.e., biological sciences, chemistry, engineering and physics. Owing to high global interest, nanotechnology has been proposed to impact the global economy by around $3 trillion by 2020, causing a requirement of almost 6 million professionals indifferent inter-related sectors. various methods can be used to increase the hurdle properties of natural polymers, inclusive of the use of polymer blends, multi-layered films, and high-barrier coating materials that contain a high-barrier film [6]. In addition to these policies, a novel technique for this purpose is the use of nanocomposites in food packaging. Nanocomposites increases barrier properties and have a positive impact on the thermal and mechanical qualities of the packaging material [7]. However, the main concern about appeal nanotechnology in food packaging is interconnected to the small sizes of the particles of nanomaterial, which is origin them to have various chemical and physical assets than their macroscale chemical counterparts [8], giving them the potential due to health problems. In this article, first, we explain briefly the different potential uses of nano-composites in food packaging. Second, we initiate skills for analyzing them. Third, we discuss the important concerns that nano-composites may potentially be hazardous materials; which would prevent their use in packaging food.

To date, many nanoparticles have been recognized as fillers for synthesizing polymer nanocomposites to enhance their packaging activities. Among them, clays and silicates have captivated significant awareness due to their layered structures. This is because of they are ample, cheap, easy to process, and provide considerable magnification (9). There are three major polymer-clay morphologies, i.e., tactoid (or phase separated), intercalated, and exfoliated (10). In the tactoid structure, which usually occurs in micro composites, the polymer chains and the clay passage are immiscible due to they have poor harmony for each other. Nanocomposite structures do not show his morphology (11). In ideal polymer-clay nanocomposites, high affinity would present between the polymer and clay, dominant to shed structures in which polymer chains penetrate into the interlayer space of the clay, making single sheets. If the clay shows a moderate affinity for the polymer, the results would be intercalated structures. In the literature, there are outlines of other particle fillers being used, including silver, zinc oxide, titanium dioxide, carbon nanotubes, graphene nanoplates, copper, and copper oxides. It is observed that graphene nanoplates (GNPs) are capable to form nanocomposites with improved thermal resistance and barrier characteristics, making them a great choice for food-packaging uses. (12)

## **Nanomaterials for Cancer Therapy:**

Cancer is a superior reason of death worldwide. From a total of 58 million deaths worldwide in 2005, cancer accounts for 7. 6 million (or13%) of all deaths. The most frequent cancer types worldwide are (a) among men: lung, stomach, liver, colorectal, oesophagus and prostate; and (b) among women: breast, lung stomach, colorectal and cervical (Pan American Health Organisation, WHO 2006).

Nanoparticles tested for anticancer drug delivery can be made from a variety of materials, including polymers, dendrimers, liposomes, viruses, carbon nanotubes, metals etc.

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| **Nanoparticle placed delivery systems** | **Medicinal and systematic use** |
| Liposomes | Managed and targeted drug delivery; Targeted gene delivery. |
| Dendrimers | Targeted drug delivery |
| Nano shells | Tumor targeting |
| Carbon nanotube | Tumor targeting |
| Fullerene based derivatives | As targeting and imaging agent |
| Gold nanoparticles | Imaging agent and Targeted delivery |
| Paramagnetic nanoparticles | As targeting and imaging agent |
| Quantum dots | As targeting and imaging agent |
| Solid lipid nanoparticle(SLN) | Controlled and targeted drug delivery |
| Nanowires | As targeting and imaging agent |

**Improved Packaging Through Nanocomposites:**

Nanocomposites, a fusion of conventional food packaging material with nanoparticles are obtain active interest in food packaging sector. In addition to its considerable antimicrobial spectrum, it shows great mechanical performance and tough opposing characteristics [13]. Nanocomposites are usually made up of a polymer matrix in a continuous ordiscontinuous phase [14]. It is a multiphase material resulting from the amalgamation of matrix (continuousphase) and a nano-dimensional material (discontinuous phase). Based on the nano-material, the nano-dimensional phase is generally characterized in to nanospheres or nanoparticles, nano whiskers or nanorods, nanotubes. [15] Nano-sized phases augment the physical characteristics of polymer, where the flexible strain is transferred to nano-strengthen material. Due to this characteristics, nanocomposite has been appreciated as a gold criteria for extemporized the physical and hurdle characteristics of polymers.

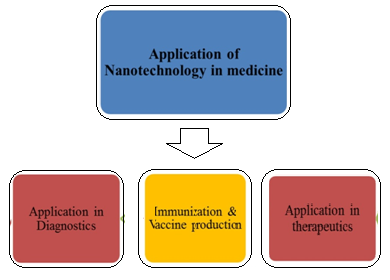
**Environmental Applications:**

Nanotechnology has become progressively a reality nowadays, and along with it there is a need for converse related to potential advances, as well as the effect on the environment and human health that technology can cause. Nanomaterials uses and also suggestions on the environment. Among their diverse applications, nanomaterials have been used for declining the toxicity of agrochemicals to non-target organisms[16]. In addition to nano-based systems, others materials can be employed as molecular carriers for agrochemicals, such as the cyclic oligosaccharides cyclodextrins[17].

There is an improving concern regarding the supportability of the methods used for the synthesis of nanomaterials. Instead of classical chemical methods, green syntheses of nanomaterials have appeared in recent years, with the use of plant extracts, fungi or bacteria in the policies.

# Bio-Stranded Nanocomposites for Food Packaging System:

The incorporation of functional nanomaterials into polymer matrices can assist in the development of food packaging materials with improved mechanical and hurdle properties. Moreover, the fundamental properties of packaging materials, such as flexibility, durability, protest to temperature, moist, and flame protection, can be further acquired by the addition and altering the different nanomaterials to enhance the quality of the food product.[18]



**Fig.1. Application of Nanotechnology in Medicine**

# Nanomedicine:

## Nanomedicine is a remarkable branch of nanoscience’s for detecting disorders by a perticular diagnosis. The diagnosis and treatment is offered using nanomaterials as agents or biomarkers[[19](#_bookmark16)]. Highly impressive pharmaceutical carriers are vital for simplifying the various health factors and disorders with lower toxicity to normal tissues.[[20](#_bookmark18)] The liposomal systems were carried out by many other scientists, and they collectively invented these uses in society for healthy life. In the improvement of liposomal-based drugs, specific lipid units play a vital role. It significantly increases the pharmacological effects [21]. The semiconducting nanomaterials, such as ZnO, CuO, and TiO2, are usually applied in drug delivery due to their functionalized securities and actions. The functionalized metal-oxide nanoparticles are found more powerful towards drug setting and delivery. They have surface rotate and urgent actions in biological systems. The garnishing surface of such nanoparticles is very studied and commonly employed for biomedical applications, including their confinementeffects and surface-to-volume area assets. Apart from the liposomes, CNT, atonic layered structures of carbon (graphene), and its oxides have also been in working. However, silicon-based pure and doped nanomaterials have molded molecular dendrimers.[22] Metal-based nanostructures, including organic and inorganic nanomaterials, have potential in biomedical areas. The ability and precision of these nano-ranged materials have number of advantages to overcome some critical health problems by the enactment of nanocarriers, markers, and bioimaging. The optical susceptibility and spectral properties of such advanced nanomaterials make them authentic for various biomedical action.

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