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A Review on Application of Nanoparticles in Biophysics

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Abstract

During last two decades, the development of nanoparticles synthesis and applications studies is the fastest growing branch of science due to their potential applications such as diagnostic and therapeutic agents and others. In this study, we resent the different types of particles and their applications with recent advances in the using of nanoparticles. In this context the Cancer therapy, drug delivery, diagnosis and biological coding are the recent innovation is addressed.

Keywords: *Nanoparticles, biophysics, gold, silver*

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INTRODUCTION

Nanotechnology is one of the fastest growing scientific fields due to its wide range of applications in all aspects of industrial and scientific usages [1]. One of the major applications in the nanotechnology is the synthesis and usage of nanoparticles. Nanoparticles show good commercial and scientific applications due to their size dependence, unique compositions and functionalities. The size of the nanoparticles are less than 100nm, which are metallic (Au, Ag, Cu, Fe), semiconducting (quantum dots), carbon based (nanotubes, fullerenes, graphene, nano-diamonds) to polymer and co-polymer based nanoparticles [2]. They are used in biomedical and biophysics researches as the size of the cells in the human body are less than 10 μm [3]. The cell parts are much smaller than the smallest nanoparticle that can be achieved. These smaller sized nanoparticles are used in drug delivery, therapy, bionanomaterials and other biological applications. Therefore, in view of this the applications of nanoparticles in biophysics is discussed.

TYPES OF NANOPARTICLES

There are many types of nanoparticles with different size, shape, composition and functionality and each type of particle is synthesised using different technique. Based on their uses in biophysical applications, we are presenting a few nanoparticles functionality and relevant application here.

Gold

Gold nanoparticles can be synthesised in different sizes and shapes, which gives the biocompatibility and good optical properties to the particles. Gold nanoparticles properties have many applications such as biochemical sensing and detection, biological imaging, diagnostics and therapy applications. Gold nanoparticles also used as cancer biomarkers and to detect heart disease. They can also transform absorbed light into heat and therefore, have high potential for infrared phototherapy [4].

Polymeric

The biodegradable and biocompatible polymers have been used to synthesis polymeric nanoparticles in the size of 10 nm to 100 nm, which are used as drug delivers through dissolved, encapsulated nanoparticle matrix. Different particle preparation methods are used to obtain the different types of nanoparticles, such as nanosphere and nanocapsule [5]. Nanocapsules are systems in which the drug is confined to a cavity surrounded by a unique polymer membrane, while nanospheres are matrix systems in which the drug is physically and uniformly dispersed [6].

Quantum Dot

Quantum nanoparticles are small semiconductor particles, which are only few nanometres, in size. Hence their optical and electrical properties differ from large particles.

Quantum dots in the size of 5 to 6 nm and 2 to 3 nm emits orange, blue and green light based on the composition. Quantum dots are highly tuneable. Hence, they are widely used in medical imaging and other biological applications.

Applications

A few applications are listed below, which are the presently established biological and biophysics applications.

- Drug and gene delivery
- Tissue engineering
- Separation and purification of biological molecules and cells
- Biodetection of pathogens
- Detection of proteins
- Fluorescent biological labels
- Probing of DNA structure
- Tumour destruction via heating (hyperthermia)

RECENT DEVELOPMENTS

Multicolour Optical Coding for Biological Assays

DNA chips have been the greater development in the field of bioengineering and bioanalytical sciences. This technology improves the research areas such as gene expression profiling, drug discovery, and clinical diagnostics to use the technology [7]. In recent days, optically encoded microbeads have been used for the analysis of biological molecules. The encoded technology uses the optical properties of the quantum dots and multicoloured quantum dots, under precise synthesis. The encoded bead technology has the advantage of specific target selection, fast binding kinetics and less cost for the production [8].

Cancer Therapy and Drug Delivery Vehicles

The targeted nanoparticles have been evaluated for the cancer therapy, because of specific and better delivery to the target. The design of multifunctional targeted nanoparticles has more benefits in the cancer therapy. These nanoparticles maybe able to detect the cancer cells, finding the location in the body, deliver of drugs to the particular cell, without side effects to the normal cell during the killing of cancer cell and real time monitoring during the treatment. The aim and scope of targeted nanoparticles used in cancer therapy as drug delivery, is the fastest growing technology [9]. Dendrimers are being investigated for both drug and gene delivery, as carriers for penicillin, and for use in anticancer therapy. The carbon nanotubes, such as Amphotericin B nanotubes show the good drug delivery efficiency and reduced toxicity.

Diagnostics

In the magnetic resonance imaging and other imaging procedure, the nanoparticles are used as radio contrast media. The radioactive metal enclosed within the buckyball is less toxic and safer in Pharmaceutical Nanosystems. This method can also be employed for imaging organs as radioactive tracers [10]. For the flu virus diagnosis the gold nanoparticles have been used, which have the antibodies attached can provide quick diagnosis. When light is incident on a virus sample and the amount of light reflected back increases because the nanoparticles cluster around virus particles, this one is the much faster test than any other test [11-12].

CONCLUSIONS

Nanoparticle synthesis can be done by different methods, based on their size, shape and type of particles. Nanoparticles are useful in the purpose of cancer therapy, diagnostics, drug delivery and other biological applications. There is a significant need for a diagnostic agent in flu virus diagnosis. Nanoparticles may be applied to find the distribution and visualization in the cells and targeted sites. Nanoparticles also can be used to monitor the drug release and long term efficiency and prediction of treatment response. Therefore, nanoparticles have good number applications in the branch of biophysics and associates, it improves the branch with tremendous future advantages.

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