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Magnetic Nanoparticles: Novel Trends and its Future Implications

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Abstract: This review is based on the synthesis properties, specifications design as well as application of magnetic nanoparticles. Nanotechnology is a multifaceted evolving field today. There are different types of Nano-particles, among all of them, magnetic Nano-particles are interestingly new, easy to prepare as well as it has many biomedical applications and uses. The characteristics of magnetic nanoparticles show applications like disease diagnosis, target drug delivery, and cancer therapy. This topic is an overview of the history, methods of preparation, advantages, and disadvantages, and biomedical application of magnetic nanoparticles. The center of attention of this topic is the challenges faced in the delivery of the drug.

***Index Terms* - Magnetic nanoparticles, Nano-particles applications, characteristics and preparations.**

I. Introduction

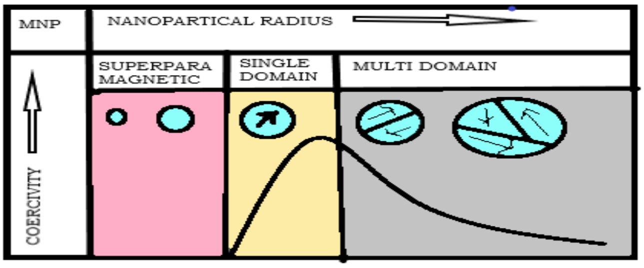
Magnetic nanoparticles offer unprecedented access to the future of medicine. Nanoparticles are sub-micron components that range in size from 1 nm to 100 n and are composed of inorganic or natural matter that can be biodegradable. Biologically degradable polymeric nanoparticles are drugs that have been combined to form medication conveyance. Liposomes, polymeric iron oxides, and other nanoparticles come in a variety of sizes, shapes, compositions, and functionalities. Magnetic nanoparticles with such properties as high magnetic field susceptibility, Curie temperature, and superparamagnetic properties are created. Magnetic nanoparticles could be collected and placed beneath a constant magnetic field. While various suitable methods for the synthesis of magnetic nanoparticles of various constitutions are being developed. In most of the predicted applications, the particle performs best when its size is less than the analytical value. [1-2]

II. Characteristics Properties Of Nanoparticles

The nanoparticles are generally classified into the organic, inorganic and carbon-based particles that has improved properties compared to larger sizes of respective materials. [2] The physical characteristics of magnetic nanoparticles and their magneto metric property are the subject of the first section of this review. The second section covers the possible use of magnetic nanoparticles for biomedical applications, with an emphasis on the benefits of using nanoparticles over micro particles and some of the most recent applications of MNPs in environmental, industrial, biological, and analytical research. The third section discusses various techniques that can be used to create these magnetic nanoparticles with an extremely narrow particle size distribution as stated in the bibliography. [3-4]

III. Physical Properties

Some of the parameters that the magnetic domain theory claims determine the critical size of a single atom are the magnitude of the magnetic saturation, the strength of the crystal anisotropy and exchange forces, the surface or domain-wall energy, and the particle form.[6]Single-domain particles lose all coercivity and turn superparamagnetic when their size drops below a particular diameter. Thermal reactions lead to superparamagnetism. When exposed to an outside magnet, nanoparticles start to become magnetic. The nanoparticles return to their nonmagnetic state. After then, it starts to decrease until it hits zero. [5-7]



IV. BIOMEDICAL APPLICATIONS

4.1 Application based on the extent of a magnetic force

It is produced when the dipolar magnetic moment of MNPs, which are tiny nanoscale magnets with a magnetic force, interacts with an external static magnetic field gradient. This interaction gave the MNPs magnetic mobility, which allowed them to travel toward greater magnetic fields. It is known as magnetophoresis. The use of magnetophoresis is flexible and has many potential uses. (A) Drug targeting using magnets. (b) Magnetofection; (c) Magnetic cell separation/purification (d) Modulated in vivo genome editing.

4.2 Nanoparticles in Chemotherapy

The most potential use of this technique is the use of nanoparticles as carriers for anticancer agents. Intravenously administered nanoparticles tend to accumulate in tumors because of their elevated endocytic activity and leaky vasculature. Polyoxyethylene's "stealth" characteristic, which more efficiently promotes extravasation, may assist the medication target cancer tissues. Simple nanoparticles can be made stealthy by using di alkyl polyoxyethylene and phospholipids or coating them in soluble polyoxyethylene. [11]

4.3 Disease Diagnosis and Detection Using Magnetic Nanoparticles

Finding and Detecting Disease Making use of magnetic nanoparticles. A lot of attention has recently been shown in the diagnostic and detection methods for magnetic NP. In order to speed up contrast switching and offer stable picture contrast of the targeted anatomical locations in -vivo, the novel magnetic NPs detect the local molecular environments.

In ex vivo diagnostics, magnetic nanomaterials are easily included into condensed biosensing systems, enabling the detection of a variety of molecular targets without the need for time-consuming sample preparation. These synergistic developments are anticipated to lead to several applications for magnetic detection in both clinical transformation and biological research. Today, early tumor diagnosis is crucial due to the rising tumor death rate. MRI is one of the methods that is frequently used to diagnose tumors. [12-13]

V. FUTURE IMPLICATIONS

Magnetic fields are now generally regarded as a tool for bioengineering treatments and approaches due to their extensive potential effects on cells and organisms and ease of application. [19]

Chemotherapy and radiation therapy are well known to be exceedingly harmful to the body. As a result, it is critical to devise a novel strategy for destroying tumor cells while limiting or completely preventing injury to crucial organs.

This section of CD-based nanoplatforms are dedicated to reporting on potential future biological applications. Because of ethical considerations, economical constraints, and material constraints, in vitro investigations are frequently more practical. [14]

VI. CONCLUSION:

The improvement in human well-being over time has been made possible by the creation of more effective treatments and medical services. In this context, we have observed the expansion of nanotechnology applications in biomedical science during the past ten years. As stated the use of magnetic nanoparticles in combination with meticulous surface engineering has produced noticeable results in the methods used for these new therapies. A key tool in controlling magnetic characteristics and colloidal stability is the precise tinkering of magnetic nanoparticle surfaces.

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