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An Overview on Nanoparticles

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Commentary

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INTRODUCTION

The word "nano" is derived from a greek word "nanos" which means very small or dwarf. The particles with 1 and 100 nanometres size are termed as nanoparticles. Nanoparticles may not exhibit size related properties but they differ from the fine particles or bulk materials. Nanoclusters have at least one dimension between 1 and 10 nanometers and a narrow size distribution. As the nanoparticles have greater surface area, the properties of conventional products will change when they come from nanoparticles [1].

Nano technology deals with the objects at smaller level i.e., at the molecular level. Nano particles can be incorporated into larger surfaces and bulk materials.

History of Nanoparticles

The history of nanoparticles dates back to 9th century in Mesapotamia. Artisans used these to generate a glittering effect on the surface of pots [2, 3].This glitter over pottery is due to a metallic film that was applied to the transparent surface of a glazing. Artisans added gold and silver oxides and vinegar on the glazed pottery. They would then keep these in a kiln at the temperature of 600°C.With the heat, the glaze would soften and migrate with the ions into the outer layers to glaze.

Rationale involved in developing Nanoparticles

- The major goal involved in the production of Nano particles are
- Decreasing the particle size
- Release of pharmacologically active agents for site specific drug delivery.
- Improving the bioavailability of the drug.
- Improving the stability of the drug.

Characterisation Techniques

Characterisation refers to the study of Physical, Chemical and Morphological characters of the product. The properties of nano particles vary significantly. Hence characterisation is the important tool. Techniques include Ion Probe Characterisation technique, Scanning Electron Microscopy (SEM), Transmission Electron Microscopy (TEM). Other characterisation techniques ***include*** XRD (X-Ray Diffraction), FTIR (Fourier Transform Infrared Spectroscopy) and NMR (Nuclear Magnetic Resonance).

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PREPARATION OF NANO PARTICLES

Nanoparticles can be prepared by attrition and pyrolysis. The most common methods include bottom up and top down techniques [4-9]. Fine sized nanoparticles can be produced by top down technique. The equipment used for top down technique are Ball mill and High Pressure Homogeniser (HPH).
Bottom up technique is useful for the drug molecules dissolved in solution. Poorly soluble drugs can be dissolved in aqueous solvent that cannot be miscible with water.
Top down technique is the recent advancement. In this technique, large molecules can be broken down into smaller API molecules. HPH is the latest innovation in the field of nanotechnology.

Figure 1: Structure of Nanoparticle

APPLICATIONS OF NANOPARTICLES

Nanoparticles have wider applications. The major applications include Targeted drug delivery. Magnetic and gold nanoparticles are useful to detect cancer [10-16]. Useful in stem cell therapy. Nanoparticles are useful in gene probing, Protein detection, vaccines, Biodetection of pathogens. Nano particles are used in medical field namely MRI(Magnetic Resonance Imaging), Optical Imaging, gene delivery and Neuro degenerative diseases. Nano particles are used in the preparation of cosmetics especially sun screen lotions. As the particles are smaller they tend to absorb more UV light. Useful in the manufacture of scratch proof eye glasses, paints, ceramic coatings for solar cells. They are useful in processing of food.Used in the preparation of chips, semiconductors etc.

Advantages of nanoparticles in drug discovery:

- Nanoparticles can deliver the drug even in the smaller areas of the body.
- Site specific drug delivery can be achieved by attaching target ligands to the surface of molecules [17, 18].
- They help in enhancing the bioavailability by increasing the aqueous solubility of poorly soluble drugs.
- They are useful in all routes of administration namely Oral, Parenteral, nasal, ocular etc.
- Controlled release of drugs can be made using nanoparticles.

Disadvantages of Nanoparticles:

- Nanoparticles can damage the immune system of the body if excessively consumed [19-21].

- Oral breathing of fine particles can lead to diseases like Silicosis, cancer and Emphysema.
- Nanoparticles cannot be absorbed through the skin as they cause irritation of the skin surface.

Recent Advances:

- Nanoparticles can be used in preparing the lithium ion batteries [21, 22].
- 3D printing and blue ray technology in DVDS are improved only because of nanotechnology.
- Nano particles are used in the preparation of Aerospace materials.

CONCLUSION AND FUTURE PROSPECTS

Nanotechnology is widely affecting the global arena [23-26]. It has wide applications in every field. Without Nanotechnology, it is hardly impossible to exist in this century. It drastically affects the human behaviour and society. Though it is a boon, it also has several limitations.
Scientists are conducting experiments to improve bio-computers which can be useful widely in the medical field. Bio-computers can sense the biomarkers and simultaneously release the counter acting agents for a specific disease [28, 29].

Ethical Issues:

Almost every technology made is expensive, would that mean that we would create two races. The wealthy modified people and poor unaltered ones?
Theoretically it was given that medical nanotechnology can help in curing night vision. But is that possible for us to achieve the goal?

If we use nanotechnology, molecular manufacturing occurs. What happens to the World economy? [30, 31]

There are still many unanswered questions which Nano scientists have to consider before it becomes late.

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