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Nanotechnology – A Review

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ABSTRACT:

This review paper look into the present aspects of "Nanotechnology". The nanotechnology has created one of the most dynamic science and technology domains at the confluence of physical sciences, molecular engineering, biology, biotechnology and medicine. Nanotechnology based systems, methods of preparation, applications, advantages and disadvantages. At present, the number of potential forms of nanomaterials available for use in biotechnological applications includes a growing list of nanoparticles, nanowires, nanofibers, nanostructures, and nanomachines. Despite the challenges, the commercialization of nanobiotechnologic products appears to have a bright future, and within 10 years many new products of this nature are likely to be approved and in use in worldwide markets.

KEYWORDS: Nanotechnology, Nanoparticles, Nanostructure, Synthesis Technic, Characteristics Technic,

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1. INTRODUCTION:

The prefix nano in the word nanotechnology means a billionth (1×10^{-9}). Nanotechnology deals with various structure of matter having dimensions of the order of a billionth of a meter. A nanometer is 10^{-9} m. Nanoparticles are generally considered to be a number of atom or molecules bonded together a radius of < 100 nm. The interest in Nano science (science of low dimensional systems) is a realization of a famous statement by Feynman that "There's a Plenty of Room at the Bottom". Based on Feynman's idea.[1] K. E. Drexler advanced the idea of "molecular nanotechnology" in 1986 in the book Engines of Creation, where he postulated the concept of using Nano scale molecular structures to act in a machine like manner to guide and activate the synthesis of larger molecules.[2]

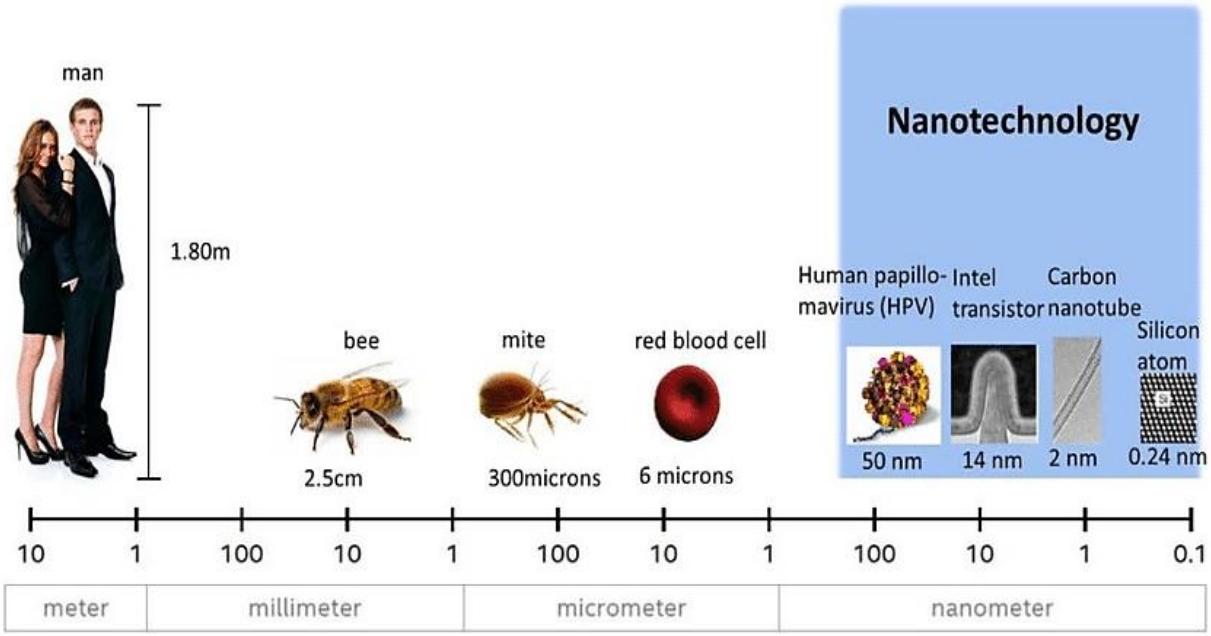

Figure 1: The scale of things of nature.

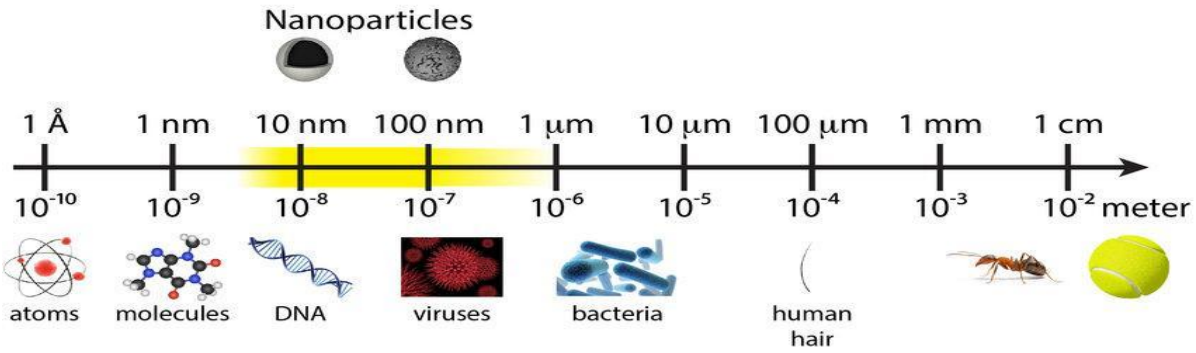

Figure 2: Representing the Nano particles with their approximate sizes.

Generally physical properties of material can be characterized by some critical length, a thermal diffusion length or a scattering length. This distance is called the mean free path or the scattering length. We define nanomaterial as those which have a characteristic length scale within about 100nm. A particle diameter, grain size layer thickness or width of conducting line on a device is some example of length scale.[3]

A group of 10^6 or less number of atoms or molecules bonded together in a cluster with the radius of about a 100nm.

SPECIAL FEATHERS OF NANOMATERIAL

Conventional materials have grains varying in size anywhere from hundreds of microns (μm) to millimeter (mm). A nanocrystalline material has grains on the order of 1-100 nanometers. The properties of bulk material are mostly retained fill the reduction of their dimensions to the micrometer range but materials in the nanometer scale show remarkably new properties.[4]

2. SYNTHESIS TECHNIQUE OF NANOMATERIAL

The interest in synthesis of nanomaterials has grown because of their distinct optical, magnetic, electronic, mechanical, and chemical properties compared with those of the bulk materials.

The exposure of exact size and shape controlled synthesis of nanostructure materials is becoming a great challenge for the nanotechnologists. Nanostructure materials have attracted a great deal of attention because their physical, chemical, electronic and magnetic properties show dramatic change from higher dimensional counterparts and depend on their shape and size.[5, 6]

CLASSIFICATION OF TECHNIQUES FOR SYNTHESIS OF NANOMATERIALS

There are two general approaches for the synthesis of nanomaterial

I. **Top- down approach**
II. **Bottom–up approach**

In Top-down approach refers to slicing or successive cutting of a bulk material to get nano sized particles. In Top-down techniques the starting material is solid state.

In Top-down approach this approach physical processing method used one is mechanical method in this method cutting, etching, grinding, ball milling. And the other is Lithographic method. In this method we used photo lithographic and Electron beam lithographic.[7, 8]

In Bottom- up approach refers to the buildup of a material from the bottom. Atom by atom, molecule by molecule. Atom by atom deposition leads to formation of self-assembly of atom or molecule and clusters. These cluster come together to from self-assemble monolayer on the surface of substrate.

In Bottom- up approach the starting material is either gaseous state or liquid state of matter. Its two type method. Physical and chemical processing methods.[9]

In physical method, physical vapor deposition (PVD), evaporation (thermal, e – beam) sputting, plasma arching, laser ablation.

In chemical method, chemical vapor deposition (CVD), PECVD, electrolatic deposition, sol-gel method, pyrolysis, microemusion route.[10]

3. CHARACTERIZATION TECHNIQUE OF NANOMATERIAL

The characterization of nanoparticles is a branch of nanometrology that deals with the characterization, or measurement, of the physical and chemical properties of nanoparticles. Nanoparticles measure less than 100 nanometers in at least one of their external dimensions, and are often engineered for their unique properties. Nanoparticles are unlike conventional chemicals in that their chemical composition and concentration are not sufficient metrics for a complete description, because they vary in other physical properties such as size, shape, surface properties, crystallinity, and dispersion state. Nanoparticles have other physical properties that must be measured for a complete description, such as size, shape, surface properties, and crystallinity and dispersion state.[11, 12] the bulk properties of nanoparticles are sensitive to small variations in these properties, which has implications for process control in their industrial use. These properties also influence the health effects of exposure to nanoparticles of a given composition.[13, 14, and 15]

We see a list of some characterization technique of nanomaterial.

1. SEM - Scanning Electron Microscopy
2. TEM - Transmission Electron Microscopy
3. HRTEM -High-Resolution Transmission Electron Microscopy
4. STEM – Scanning Transmission Electron Microscopy
5. AFM – Atomic Force Microscopy
6. STM – Scanning Tunneling Microscopy
7. XRD – X – Ray Diffraction

8. EDX – Energy Dispersive X- Ray Diffraction
9. DC-C - DC-Conductivity
10. PSA – Particle Size Analysis
11. UV- Vis - UV- Visible Spectroscopy
12. TG/DTA – Thermo Gravimetric Analysis / Differential Thermal Analyzer

4. CONCLUSION:

While current investigations have focused on the generation of nanoparticles and nanostructures, a shift towards nanoparticles processing and imaginative utilization is noticeable.

Future work is expected to expand basic understanding of nanoscale phenomena and mechanisms, combine synthesis and assembling in to function.

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