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Review: Application of Nanomaterial in Diferrent Areas

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***Abstract* -There are many applications of nano-materials like nanoparticles and nanoclusters in different areas of science. Nanoparticles used in crop biotechnology to improve crops and their utility in agricultural production. Nanoclusters used in medicine and also curing in cancer treatment and tumor detection. Nanoparticles and nanoclusters also take part in treatment of agricultural wastes, nutrients, plant hormones, food industry, oil industry and in future, it used in nano-tube, nano-star, nano-rod synthesis.**

***Index Terms*— application, nanoparticles, nanoclusters etc**

I. INTRODUCTION

Nanoparticles are particles between 1 and 100 nanometers in size. In nanotechnology, a particle is defined as a small object that behaves as a whole unit with respect to its transport and properties. Particles are further classified according to diameter [1]. Nanoparticles are of great scientific interest as they are, in effect, a bridge between bulk materials and atomic or molecular structures. A bulk material should have constant physical properties regardless of its size, but at the nano-scale size-dependent properties are often observed .Thus, the properties of materials change as their size approaches the nano-scale and as the percentage of the surface in relation to the percentage of the volume of a material becomes significant. For bulk materials larger than one micrometer (or micron), the percentage of the surface is insignificant in relation to the volume in the bulk of the material. The interesting and sometimes unexpected properties of nanoparticles are therefore largely due to the large surface area of the material, which dominates the contributions made by the small bulk of the material. Nanocluster is a grouping of a number of nanoparticles. Nanoclusters have at least one dimension between 1 and 10 nanometers and a narrow size distribution. The size of nanoclusters ranges from sub-nanometer to 10 nm in the diameter. In nanotechnology, a particle is defined as a small object that behaves as a whole unit with respect to its transport and properties. Nanoclusters have certain specific properties. Nanoclusters constitute an intermediate state of matter between molecules and solids. Nanoclusters are of technological interest in numerous areas of applied science (e.g. materials science, catalysis, (opto-electronics). They are fine aggregates of atoms or molecules.

Nanoclusters consisting of up to a couple of hundred atoms, but larger aggregates containing 1000 or more atoms are called Nanoparticles. They are bound by forces, which may be metallic, covalent, ionic, or hydrogen bonds or Vander Waals forces.

There are many fields where scientist creates the different area of research in nanotechnology like in crop improvement, medicine, agriculture etc. (fig1).

II. CROP BIOTECHNOLOGY

Nanoparticles used as bullet target genes which containing resistance from herbicide, pesticide and chemical which closely effect to human and living beings. Nano-capsules can enable effective penetration of herbicides through cuticles and tissues, allowing slow and constant release of the active substances [2]. MSNs (mesoporous silica nanoparticle) are chemically coated and serve as containers for the genes delivered into the plants. The coating triggers the plant to take the particles through the cell walls, where the genes are inserted and activated in a precise and controlled manner, without any toxic side or after effects. This technique has been applied to introduce DNA successfully to tobacco and corn plants. [3]

III. AGRICULTURAL WASTE

Cotton is processed into fabric or garment; some of the cellulose or the fibers are discarded as waste or used for low-value products such as cotton balls, yarns and cotton batting. With the use of newly-developed solvents and a technique called electro-spinning, scientists produce 100 nanometer-diameter fibers that can be used as a fertilizer or pesticide absorbent. These high-performance absorbents allow targeted application at desired time and location [4] .Ethanol production from maize feedstocks has increased the global price of maize in the past two years. Cellulosic feedstocks are now regarded as a viable option for bio-fuels production and nanotechnology can also enhance the performance of enzymes used in the conversion of cellulose into ethanol. Scientists are working on nano-engineered enzymes that will allow simple and cost-effective conversion of cellulose from waste plant parts into ethanol [5].

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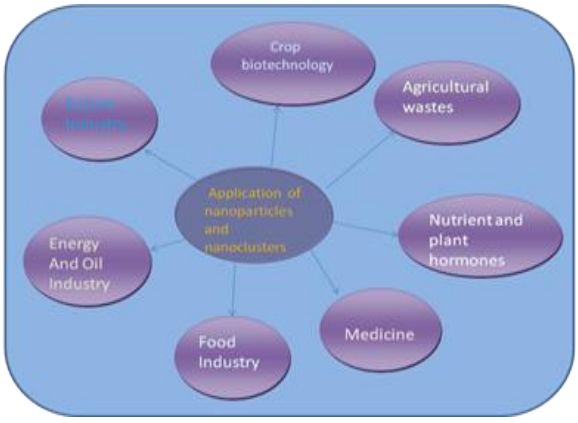

Fig1. Application of nanomaterial in different areas

IV. NUTRIENTS AND PLANT HORMONES

Multiple pathogens in a farm which can easily be detected using any fluorescent-based equipment. This on-going project generally aims to develop a portable on-site detector which can be used by non-trained individuals. The project, in cooperation with the U.S. Department of Agriculture is expected to be completed towards the end of 2011 [6]. Scientists are able to study plant's regulation of hormones such as auxin, which is responsible for root growth and seedling establishment. Scientists at Purdue University developed a nanosensor that reacts with auxin. This interaction generates an electrical signal which can be a basis for measuring auxin concentration at a particular point. The nanosensor oscillates, taking auxin concentration readings at various points of the root. A system of formulas then verifies if auxin is absorbed or released by the surrounding cells. This is a breakthrough in auxin research because it helps scientists understand how plant roots adapt to their environment, especially to marginal soils [7].

V. MEDICINE

Nanoparticles and nanoclusters also used in medicinal purposes and curing and detection of tumor and cancerous cells. With the uses of nanoparticles it application in field of Fluorescent biological labels [8] ,Drug and gene delivery [9] ,Bio detection of pathogens [10] ,Detection of proteins [11] ,Probing of DNA structure [12] , Tissue engineering [13] ,Tumor destruction via heating (hyperthermia) [14] ,Separation and purification of biological molecules and cells [15] ,MRI contrast enhancement [16], Phagokinetic studies[17] . Titanium is a well-known bone repairing material widely used in orthopedics and dentistry. It has a high fracture resistance, ductility and weight to strength ratio. Unfortunately, it suffers from the lack of bioactivity, as it does not support cell adhesion and growth well. Photodynamic cancer therapy is based on the destruction of the cancer cells by laser generated atomic oxygen, which is cytotoxic. Gold nanoparticles are widely used in immunohistochemistry to identify protein-protein interaction. As surface chemistry for fictionalization of metal surfaces is well developed, different ligands can be selectively attached to different segments. For example, porphyrins with thiol or carboxyl linkers were simultaneously attached to the gold or nickel segments respectively. Thus, it is possible to produce magnetic nano-wires with spatially segregated fluorescent parts.

VI. FOOD INDUSTRY

A bright future is coming of nanopaticles and nanoclusters in food and nutrients e.g. Food proteins (e.g., native beta-lacto globulin, which is about 3.6 nm in length) can undergo denaturation (via pressure, heat, pH, etc.) and the denatured components reassemble to form larger structures, like fibrils or aggregates, which in turn can be assembled to form even larger gel networks (e.g., yogurt). Protein-polysaccharide mixed solutions can spontaneously separate into a phase with nano- or micro-sized droplets dispersed in a continuous phase. Starch granules expand when heated and hydrated releasing biopolymers that can be recrystallized into nano-sized structures (e.g., recrystallized amylose regions may be about 10–20 nm); dextrins and other degradation products of extrusion can be used to encapsulate bioactive substances in micro-regions, etc. While many people think of fats as being homogeneous liquids or solids, in fact some fats have a lot of structure. Monoglycerides, for example, can self-assemble into many morphologies at the nanoscale level, and hierarchically structured into tryglicerides can be crystallites (10–100 nm), followed by arrangment into large clusters, then flocs, and finally, fat crystal networks. Fat crystal networks give foods spreadability, texture, and other similar properties [18].

VII. ENERGY AND OIL INDUSTRY

Nanosensors, ranging from 1-100 nm, have captured the attention and imagination of petroleum geologists [19]. Nanoparticles with noticeable alterations in optical, magnetic, and electrical properties compared to their bulk counterparts are excellent tools for the development of sensors and the formation of imaging contrast agents [20]. Hyperpolarized silicon nanoparticles provide a novel tool for measuring and imaging in oil exploration [21]. There are now several active and promising programmes to develop nanosensors compatible with temperature and pressure ratings in deep wells and hostile environments. Nanosensors are deployed in the pore space by means of "nano-dust" to provide data on reservoir characterization, fluid-flow monitoring, and fluid-type recognition [22]. In addition, nanotechnology has the potential to help develop geothermal resources by enhancing thermal conductivity, and nano-based materials could be used for geothermal production. Nanoscale metals have already been used to delineate ore deposits for geochemical exploration [23].

VIII. FUTURE

There are numerous areas of the petroleum, oil and medicinal industry where nanoparticles and nanoclusters can contribute to more efficient, less expensive, and more environmentally technologies than those that are readily available. The future possibilities for nanotechnology in the petroleum industry are identified [24-26] .Ogolo [27] used nanoparticles oxides of Aluminum, Zinc, Magnesium, Iron, Zirconium, Nickel, Tin

and Silicon. It was imperative to find out the effect of these nanoparticle oxides on oil recovery since this is the primary objective of the oil industry. Improved success of exploration by improving data gathering, recognizing shallow hazards, and avoiding dry holes; Nanotechnology-enhanced materials that provide strength and endurance to increase performance and reliability in drilling, tubular goods, and rotating parts, Improved elastomers, critical to deep drilling and drilling in high-temperature/high-pressure environments.. Production assurance in diagnostics, monitoring surveillance, and management strategies, Corrosion management for surface, subsurface, and facilities applications ,Lightweight, rugged materials that reduce weight requirements on offshore platforms, and more reliable and more energy-efficient transportation vessels, Selective filtration and waste management for water and carbon nanotube applications, Enhanced oil and gas recovery through reservoir property modification, facility retrofitting, gas property modification, and water injection, Refining and petrochemicals technologies.

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Topic of Research – Biological application of nanomaterials and their effect to environment, Synthesis of Nanomaterial and their application.