A REVIEW OF APPLICATIONS OF NANOTECHNOLOGY IN DIFFERENT AREAS

Ravneet Kaur
Assistant Professor
Department Of Applied Sciences,
Gulzar Group Of institutes Ludhiana , India

Abstract *:*Nanotechnology is helping to enhance, revolutionize, many technology and Industry sectors such as environmental science, information technology, energy, medicine, crystalline structures homeland security, food safety, transportation among many others .The rapid progress of nanotechnology in other key industries may over time be transferred to agricultural applications as well, and facilitate their development.. Now a days nanotechnology current progress is in chemistry, physics, materials science, and biotechnology to create new materials that have unique properties because their structures are determined on the nanometer scale .This paper summarizes the various applications of nanotechnology in recent decades.

Index Terms – **Nanotechnology, Crystalline structure, Bio technology**

I. INTRODUCTION

When the size of a material is reduced to nanometer range chemical, physical and biological properties of the material changes which are entirely different from the properties of their individual atoms, molecules or bulk materials (Tomar, 2012). The explanations behind these progressions are huge surface zone to volume proportion, spatial repression, enormous surface vitality, and diminished flaw. Higher hardness, super flexibility at high temperature, improved breaking quality and expanded facture durability are the significant mechanical properties that are extensively improved.. At nanoscale, the surface zone to volume proportion increments and accordingly more iotas are presented to the surface in this manner making surface properties more overwhelming than the properties of the mass material. Subsequently compound reactivity and one of a kind material properties are presented. These upgraded properties help in opposition against oxidation, mechanical scraped spots, erosions and high temperature (Kantamneni et al., 2013).

1.1 Sustainable Energy Application

The difficulty of meeting the world's energy demand is compounded by the growing need to protect our environment. Numerous researchers are finding the approaches to grow spotless, moderate, and sustainable power sources, alongside intends to decrease vitality utilization. Model sun based boards consolidating nanotechnology are more productive than standard plans in changing over daylight to power, promising modest sun based power later on. Nano organized sunlight based cells as of now are less expensive to fabricate and simpler to install. Nanotechnology is improving the efficiency of fuel production from normal and low-grade raw petroleum materials through better catalysis, as well as fuel consumption efficiency in vehicles and power plants through higher-efficiency combustion and decreased friction (Low et al., 2015). Nano-bioengineering of enzymes is aiming to enable conversion of cellulose into ethanol for fuel, from wood chips, corn stalks and unfertilized perennial grasses. Nanotechnology is as of now being utilized in various new sorts of batteries that are less combustible, speedier charging, increasingly effective, lighter weight, and that have a higher power density .

Nanotechnology could help meet the need for affordable, clean drinking water through rapid, low-cost detection of impurities in and filtration and purification of water (Rabbani et al., 2016; Sobolev and Shah, 2015;Mishra et al., 2012).Nanoparticles will someday be used to clean industrial water pollutants in ground water through chemical reactions that render them harmless, at much lower cost than methods that require pumping the water out of the ground for treatment. Nanotechnology has the real potential to revolutionize a wide array of medical and biotechnology tools and procedures so that they are more personalized, portable, cheaper, safer, and easier to manage. Below are some examples of important advances in these areas. Researchers have developed an imaging technology to measure the amount of an antibody-nanoparticle complex that gathers specifically in plaque. Clinical scientists are able to monitor the development of plaque as well as its disappearance following treatment. Gold nanoparticles can be used to detect early-stage Alzheimer‟s disease[1].

II. MEDICINE APPLICATION

Quantum dots are semiconducting nanocrystals that can enhance biological imaging for medical diagnostics. When illuminated with ultraviolet light, they emit a wide spectrum of bright colours that can be used to locate and identify specific kinds of cells and biological activities. These crystals offer optical up to 1,000 times better than conventional dyes used in many biological tests, such as MRIs, and render significantly more information. Multifunctional therapeutics where a nanoparticle serves as a platform to facilitate its specific targeting to cancer cells and delivery of a potent treatment, minimizing the risk to normal tissues (Adam et al., 2015, Milliron, 2014, Peterson et al., 2014, Schnitzenbaumer and Dukovic, 2014)..

Nanotechnology in medicine currently being developed involves employing nanoparticles to deliver drugs, heat, light or other substances to specific types of cells (such as cancer cells). Particles are built with the goal that they are pulled in to unhealthy cells, which permit direct treatment of those cells. This technique reduces damage to healthy cells in the body and allows for earlier detection of disease. Specialists are additionally proceeding to search for increasingly powerful techniques to target nanoparticles conveying restorative medications straightforwardly to unhealthy cells. For instance researchers have shown expanded degrees of medications conveyance to tumors by utilizing two sorts of nanoparticles. The primary sort of nanoparticle finds the malignant growth tumor and the second kind of nanoparticle (conveying the restorative medications) homes in on a signal generated by the first type of nanoparticle. One treatment under development involves targeted chemotherapy that delivers a tumor-killing agent called tumor necrosis factor alpha (TNF) to cancer tumors. TNF is appended to a gold nanoparticle alongside Thiol-derivatized polyethylene glycol (PEG-THIOL), which conceals the TNF bearing nanoparticle from the insusceptible framework. This permits the nanoparticle to course through the circulation system without being assaulted.

Researchers at MIT are developing nanoparticles designed to pass through the brain barrier and target tumors of a type of brain cancer called glioblastoma, delivering two chemothreapy drugs to the tumor.Researchers at the University of Tornoto have demonstrated the use of manganese dioxide nanoparticles designed to concentrate in a tumor and generate oxygen can increase the effectiveness of the chemotherapy drug doxorubicin.Researchers at UCLA have demonstrated the use of mesoporous silica nanoparticles to deliver the chemotherapy drug irinotecan to pancreatic cancer tumors. Testing on mice indicates that this method reduces the toxity of the chemotherapy.

A technique being created to battle skin malignant growth utilizes gold nanoparticles to which RNA particles are appended. The nanoparticles are in a balm that is connected to the skin. The nanoparticles infiltrate the skin and the RNA connects to a disease related quality, preventing the quality from creating proteins that are utilized in the development of skin malignant growth tumors.

III. APPLICATIONS OF NANOTECHNOLOGY IN AUTOMOBILES

Nano scale sensors and devices may provide cost-effective continuous structural monitoring of the condition and performance of bridges, tunnels, rails, parking structures,and pavements over time. Nano scale sensors and devices may also support an enhanced transportation infrastructure that can communicate with vehicle-based systems to help drivers maintain lane position, avoid collisions, adjust travel routes to circumnavigate congestion, and other such activities (Agzenai et al., 2015; Firoozi et al., 2015; Golestani et al., 2015; Singh and Sangita, 2015, Sobolev, 2015; De Nicola et al.,2015; Chuah et al., 2014; Firoozi et al., 2014; Wong, 2014; Yusoff et al., 2014)[3].

Most of the researches and developments based on nanotechnology are in automobile sector as we rely on it more frequently contrasted to air or water transportation. Nanotechnology is applied to body parts, emissions, under carriage , chassis and tires, automobile interiors, electrics and electronics, engines and drive trains. The important parts of automobiles those are shaped by nanotechnology is depicted in Fig. 1.

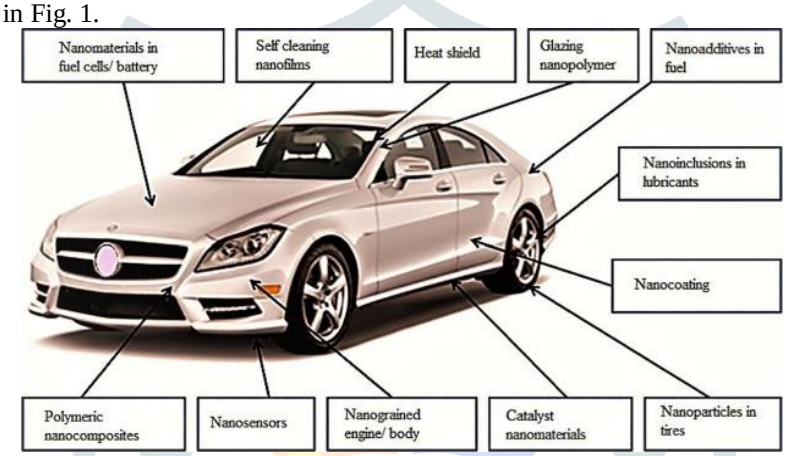

Fig. 1. Various parts of automobile in which nanotechnology is applied (Not representing the actual vehicle)

The new look of vehicle body shell ought to be ensured following a few washes and numerous long stretches of tasks. Scratch as well as scraped spot superficially will harm the coatings. They may likewise harm the fundamental covering layers. It is a challange for researchers and specialists to create scratch and scraped spot safe coatings without influencing their different properties. In customary strategy, by conferring huge number of cross connections in the folio of the coatings can improve the scratch obstruction however they have low effect opposition because of their less adaptability.On the other hand, a less cross linked coatings will have better performances like anti- fingerprint and resistance to impact but will have less abrasion and scratch resistance (Mathiazhagan and Joseph, 2011). The use of siloxane encapsulated SiO_2 nanoparticles to produce a scratch and abrasion resistant films have been reported by Glasel et al. (2000). Due to the homogeneous distribution of nanoparticles in the polymer, scratch resistance property can be improved without sacrificing any other properties. Nano alumina have also shown positive response in this aspect.

The performance of the alumina nps dispersed coating was compared with the neat coating and is expressed as X times improvement with the neat coating. It is clear that the alumina nps significantly improve the performance of the coating, up to nine times, even at very low concentration of alumina dispersed in the composite coating(Khanna, 2008).

With respect to the conventional paints, nano-varnish results in higher scratch resistance and good paint brilliance. The reason for this technological effect is the embedded ceramic particles which are added to the varnish layer in nanometer range. The most commonly used nanoparticles in the varnish is Degussa's AEROSIL R9200 and this accounts to improve the scratch resistance property of the automobile body shell (Matthias et al., 2008). It is nothing but special type of silica nanostructured powder in gaseous phase which synthesis in flame and therefore called as pyrogenic constitute. Silica tetrachloride is the best suited pyrogenic constitute. If the paint is liquid, the particles can be randomly distributed in solution. At the time of drying and hardening processes, the particles crosslink with each other deeply and gives the paint matrix molecular structure (Seubert et al., 2008). These types of nanopaints are already being used in different models of Mercedes Benz [3].

IV.Nanotechnology for Environmental Protection

Highly toxic organic compounds have been synthesized and released into the environment in order to be used directly or indirectly over a long period. Among some of these elements are pesticides, fuels, polycyclic aromatic hydrocarbons (PAHs), and polychlorinated biphenyls (PCBs) (Jones, 2007). Some combined chemical compounds resist highly against biodegradation via native flora in comparison with organic substances easily degraded through introduction into the environment. Thus, dangerous chemical compounds have been one of the most serious issues in the contemporary world. The management of contaminated soil and ground water is a major environmental concern. The presence of elevated concentrations of a wide range of contaminants in soils,sediments and surface-and ground waters, affects the health of millions of people worldwide (Pereira et al.,2003). Current clean up technology is not significantly and economically adequate to solve all of today"s clean up needs.

Nanotechnology is one of the most important trends in science and perceived as one of the key technologies of the present entury (Zhang and Elliot, 2006). Nanotechnology could be a powerful tool in dealing with pollution remediation. Several studies indicate that combining nanoparticles with conventional treatment could increase the efficiency of contaminants removal, such as organic materials. In Zhang"s report (Rickerby and Morrison, 2007), nano scale iron particles are very effective for the transformation and detoxification of a wide variety of common environmental contaminants, such as chlorinated organic solvents, organochlorine pesticides, and PCBs. Nanoparticles remain reactive towards contaminants in soil and water for extended periods of time and rapid in situ reactions have been observed with TCE reduction up to 99% in a few days after the nanoparticle injection. Many researchers have shown that engineered nanoparticles such as TiO2 and ZnO, carbon nanotube, metallic nanoparticles (e.g., iron,nickel) magnetic nanoparticles and amphiphilic polyurethane nanoparticles could be useful for remediation and treatment of contaminated water, soil or air.

Utilization of nanotechnology in natural science is arranged into these four sections: remediation, insurance, support, and improvement. Among these four, remediation is known as the most quick developing classification, security and support make the primary piece of nanotechnology application in natural science, while ecological improvement speaks to the littlest piece of nanotechnology application classes. Nanoparticles can be used in air and water treatment, mesoporous components for green science, reactant applications and natural sub-atomic science. Along with decreasing the size of the particles, they gain new chemical, electronic and physical properties. Advantages include improved adsorption and unique catalytic properties that can accelerate oxidation or reduction reactions with different contaminants for particle that are less than 10 nm (Cosgun et al., 2015). Nanoscale materials have been at a number of contaminated sites with preliminary reports of success.

Nanotechnology is also able to improve the environment via presenting influential control and preventing of contamination. For environmental treatment, different implementations of nanotechnology have been successfully implemented at the laboratory scale. However, mostly these applications need confirmation of their effectiveness and safety in the field. Traditional remediation technologies have indicated confined efficacy in reduction of the concentration of contaminations in air, water, and soil. According to Boehm (Dang et al., 2015) nanomaterials can act more remarkably and influentially as filtration media in comparison with bigger particles with the same chemicals (Yang et al., 1999).

V. Application of Nanotechnology in Food and Agriculture

The current worldwide populace is almost 6 billion with half living in Asia. A huge extent of those living in creating nations face day by day sustenance deficiencies because of ecological effects or political flimsiness, while in the created world there is a nourishment excess. For creating nations, the drive is to create dry spell and bug safe harvests, which additionally expand yield.. In created nations, the nourishment business is driven by buyer request which is as of now for fresher and more beneficial staples. This is enormous business, for instance the nourishment business in the UK is blasting with a yearly development rate of 5.2% and the interest for crisp sustenance has expanded by 10% over the most recent couple of years. The capability of nanotechnology to change the social insurance, material, materials. Data and correspondence innovation, and vitality segments has been well-advertised. In fact, several products enabled by nanotechnology are already in the market, such as antibacterial dressings, transparent sunscreen lotions, stain-resistant fabrics, scratch free paints for cars, and self-cleaning windows. The application of nanotechnology to the agricultural and food industries was first addressed by a United States Department of Agriculture roadmap published in September 2003. The prediction is that nanotechnology will transform the entire food industry, changing the way food is produced, processed, packaged, transported, and consumed. This short report will review the key aspects of these transformations, highlighting current research in the agri food industry and what future impacts these may have[2].

Nanotechnology has the potential to revolutionize the agricultural and food industry with new tools for the molecular treatment of diseases, rapid disease detection, enhancing the ability of plants to absorb nutrients etc., Smart sensors and smart delivery systems will help the agricultural industry combat viruses and other crop pathogens. In the near future nanostructured catalysts will be available which will increase the efficiency of pesticides and herbicides, allowing lower doses to be used. Nanotechnology will also protect the environment indirectly through the use of alternative (renewable) energy supplies, and filters or catalysts to reduce pollution and clean-up existing pollutants. An agricultural methodology widely used in the USA, Europe and Japan, which efficiently utilises modern technology for crop management, is called Controlled Environment Agriculture (CEA). CEA is an advanced and intensive form of hydroponically-based agriculture. Plants are grown within a controlled environment so that horticultural practices can be optimized. The computerized system monitors and regulates localised environments such as fields of crops CEA is a progressed and escalated type of hydroponically-based horticulture. Plants are developed inside a controlled situation with the goal that green practices can be streamlined. The automated framework screens and directs limited situations, for example, fields of yields. CEA innovation, as it exists today, gives an astounding stage to the acquaintance of nanotechnology with farming. With a large number of the observing and control frameworks as of now set up, nano mechanical gadgets for CEA that give "exploring" capacities could enormously improve the grower"s capacity to decide the best time of collect for the harvest, the essentialness of the yield, and nourishment security issues, for example, microbial or synthetic sullying.To maintain crop yields, Integrated Pest Management systems, which mix traditional methods of crop rotation with biological pest control methods, are becoming popular and implemented in many countries, such as Tunisia and India[2].

Advances, for example, exemplification and controlled discharge techniques, have changed the utilization of pesticides and herbicides. Numerous organizations make details which contain nanoparticles inside the 100-250 nm size range that can break down in water more viably than existing ones (in this manner expanding their action). Different organizations utilize suspensions of nanoscale particles (nano-emulsions), which can be either water or oil-based and contain uniform suspensions of pesticidal or herbicidal nanoparticles in the scope of 200-400 nm. These can be effectively fused in different media, for example, gels, creams, fluids and so on., and have various applications for precaution measures, treatment or protection of the collected product.New investigate additionally means to make plants use water, pesticides and manures all the more productively, to lessen contamination and to make agribusiness all the more ecologically amicable.Agriculture is the backbone of most developing countries, with more than 60% of the population reliant on it for their livelihood. As well as developing improved systems for monitoring environmental conditions and delivering nutrients or pesticides as appropriate, nanotechnology can improve

our understanding of the biology of different crops and thus potentially enhance yields or nutritional values. In addition, it can offer routes to added value crops or environmental remediation. Particle farming is one such example, which yields nanoparticles for industrial use by growing plants in characterized soils. For example, research has shown that alfalfa plants grown in gold rich soil, absorb gold nanoparticles through their roots and accumulate these in their tissues. The gold nanoparticles can be mechanically separated from the plant tissue following harvest[1].

VI. CONCLUSION

Based on the review in this paper, Nanotechnology can possibly be the way to a shiny new world in the fields of nourishment and agribusiness, development materials, mechanical, prescription and electrical designing. In spite of the fact that replication of regular frameworks is a standout amongst the most encouraging regions of this innovation, researchers are as yet attempting to get a handle on their surprising complexities.Besides, nanotechnology and nanomaterials is a quickly developing zone of research where new properties of materials on the nano-scale can be used to support modern and various fit advancements exist that can conceivably change the administration life and life-cycle cost of development framework to make another world in future.

REFERENCES

[1] Shariat Mobasser and Ali Akbar Firoozi," *Review of Nanotechnology Applications in Science and Engineering*", Journal of Civil Engineering and Urbanism, Volume 6, Issue 4: 84-93; July 25, 2016

[2] R. Kalpana Sastry H.B.Rashmi N.H.Rao S.M.Ilyas," *Integrating nanotechnology into agri-food systems research in India: A conceptual framework",*Elsevier –Technological Forecasting and Social change, Volume 77, Issue 4, May 2010

[3] JinuMathew JosnyJoy Soney C.George," Potential applications of nanotechnology in transportation: A review" ,Journal of King Saud University - Science

[4] Low J, Yu J, Ho, W. ," *Graphene-Based Photocatalysts for CO2 Reduction to Solar Fuel*", The journal of physical chemistry letters, 6(21): 4244-4251.

[5] Chaturvedi S, and Dave PN ,"Emerging applications of nanoscience", Paper presented at the Materials Science Forum, 152-159.

[6] Jalaja K, Naskar D, Kundu S.C, James NR.,"*Potential of electrospun core–shell structured gelatin–chitosan nano fibers for biomedical applications*", Carbohydrate polymers, vol. 136, 1098-1107.

[7] Maine E, Thomas V, Bliemel M, Murira A, Utterback J.,"*The emergence of the nanobiotechnology Industry*". Nature nanotechnology, 9(1): 12-15.
[8]NelsonK. Akafuah, Sadegh Poozesh, Ahmad Salaimeh, GabrielaPatrick, Kevin Lawler, Kozo Saito,"*Evolution of the automotive body coating process—a review*" Coatings, 6 (2) (2016), p. 24

[8] Fan W, Shi J, Bu W.," *Engineering Upconversion Nanoparticles for Multimodal Biomedical Imaging-Guided Therapeutic Applications Advances in Nanotheranostics*". Springer, 165-195

[9] Yashveer S, Singh V, Kaswan V, Kaushik A, & Tokas J.," *Green biotechnology, nanotechnology and bio-fortification: perspectives on novel environment-friendly crop improvement strategies*." Biotechnology and Genetic Engineering Reviews, 30(2): 113-126.