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Role of Nanotechnology in Chemical Industry

Dr. Yogesh Kumar Chahar

Professor in Chemistry, SBD Govt. College, Sardarshahar, Churu, Rajasthan, India

ABSTRACT

Polymers are produced in chemical industries and changes can be made in their structure through nanotechnology to use them for other chemical applications and industrial processes. Nanotechnology is used for the synthesis of chemical compounds in chemical industries that are used for the synthesis of electricity in cheap ways. Chemical industries synthesized the useful products and chemical compounds with high costs and larger amount of energy required for their production. Different types of nanoparticles such as silver, golden and green synthesis have been made process in these days. This approach for engineering based for nanoparticles utilized for different types of ceramics and spectroscopy. The use of engineered Nano fibers already makes clothes water- and stain-repellent or wrinkle-free. Nanoparticles are used as a coating to improve the smoothness and heat resistance of common household equipment such as the flat iron. Catalysis in combination of nanotechnology has become the most industrial trend to accelerate the reactions at different sectors at low cost and high-quality final product. Different approaches are used using nanotechnology to improve the chemical techniques to improve their strength and working capacity.

KEYWORDS: *nanotechnology, chemical, industry, capacity, polymers, catalysis*

INTRODUCTION

Chemical engineers integrate lab-developed processes into commercial manufacturing processes and then strive to maintain and enhance them. They depend on engineering fundamentals like arithmetic, physics, and chemistry. Chemical engineering is most typically seen in large-scale production operations, where the objective is to improve efficiency and product quality while reducing costs. The aviation, automobile, pharmaceutical, electronic, industrial, healthcare, and defense sectors employ chemical engineering to manufacture and enhance their technological products. Examples of these products include ultra-strong fibers, textiles, and adhesives for automobiles; biomimetic materials for implants and prostheses, and coatings for semiconductor applications.

Chemical engineering has matured to the point that numerous commodity items based on well-established methods are available. It is common knowledge that a material's micro and nanostructure, in conjunction with its chemical composition, is crucial in defining its qualities. Controlling the microstructure as well as composition at the micro and nanoscale is therefore critical for future breakthroughs. [1,2]

Nanotechnology can be used to manipulate the structure of nanomaterials to enhance their properties. Also, nanotechnology can offer insights into a particle's crystallite and agglomerate size due to the multiple characterization techniques available.

Polymers manufactured in the chemical industry have their structure altered using nanotechnology for use in different chemical applications and industrial activities. Catalysis is a procedure that is often employed in the chemical industry to improve the efficiency of the synthetic chemistry of compounds by speeding up the reaction. Nanotechnology is now being utilized in the chemical industry to develop rules to increase the catalytic performance of industrially manufactured goods.

Nanotechnology is used to clean ceramic and other commercial materials. Ceramic surfaces contain chemicals and industrial wastes that must be removed and cleaned. Nanoparticles are employed to clean surfaces and defend them from environmental damage. Due to their long shelf life, these nanomaterials are effective for extended periods.

Various technologies are employed to increase chemical filtration processes' strength and operating capacity. Nano-filtration is one of the major uses of nanotechnology in chemistry owing to its breakthroughs in compound production at the nanoscale level. Filtration may be done using technical or chemical methods such as using nano walls with specific pore diameters that allow only liquid to pass through membranes.

Coatings- Most examples are to be found in the field of surface treatments like coatings, paints, and texturing surface. Example: Self-cleaning surfaces Reduction of adhesion is relevant for many applications. For example is the reduction of adhesion one approach to substitute antifouling agents like TBT. In addition the use of cleaning agents could be reduced or even made superfluous. If these coatings are used to cover cladding it is assumed that the use of paint will reduce considerably.

Flame Retardants- There are several approaches to replace bromine flame retardants with products using NT. Bromine is used as a reaction inhibitant by absorbing oxygen. A similar effect could be realised by nanoparticles. If TiO_2, SiO_2, MgO, or ZnO nanoparticles are added to substances oxygen is accumulated and builds up an oxide layer.

Flexibiliser- Flexibiliser leads to elastic bindings between the polymer chains. It is known from tires that the addition of nanoparticles can enhance the flexibility of the rubber mixture. A similar effect is conceivable with plastics.

Substitution or Reduction of Solvents- Organic solvents or volatile organic compounds (VOC) in general are one group of chemicals which are often toxic, bio-accumulative and, due to their volatility, difficult to control. Solvents can not be directly substituted by NT. But in the literature it is often mentioned that NT may change processes in a way that in some cases solvents can be reduced or will even become dispensable in future.[3,5]

Catalysts- Research on catalysts is an old and vast research field. In this field, the distinction between 'pure' chemistry and nanotechnology is especially difficult. Research in this field was already in the dimension of nanometers, therefore it is not clear to which extent further developments may be attributed to NT. The development of new catalysts is seldom directly aimed at substituting hazardous substances. Instead, in the development of new catalysts several objectives are pursued at the same time. Therefore, substitution of hazardous substances in this field is often very indirect. The effect of catalysts on human health and the environment, if they are released, could be detrimental. Their benefits and risks have to be balanced in detail. A very well investigated example of a case of substitution is styrol synthesis where it was possible to reduce the by-production of heavy metals due to NT catalysts.

Other Examples: Drug Targeting- Within NT there exist several attempts to improve the efficiency of pharmaceuticals by bringing them directly to the cells where they are needed. Of course, the main goal is to reduce the side effects of the therapy, hence making the therapy more tolerable and effective. But especially chemotherapeutics are detrimental for the environment and the release of antibiotics causes severe problems due to resistance of bacteria.

REMEDIATION- A lot of the literature concerning nanotechnology and environmental issues deals with the potential of NT for cleaning up polluted air, water, and soil. Most of the research activities concerning the development and use of catalysts in respect to hazardous substances are not in order to avoid them but to decompose them after they have been released into the environment. These examples are not within the scope of the project. Nevertheless, it should be mentioned that most articles on environmental benefits attributed to NT are of this nature.

DISCUSSION

Effective Materials in the chemical Industry give a particular advantage: Pharmaceuticals collaborate with microorganisms, structured polymers support mechanical pressure and paints give corrosion resistance.

Over the previous years nanotechnology has gotten increasingly more significant in the advancement of coatings. The analysts and businesses accepts that inside the following 10 years all throughout the planet around 20 % of the turnover of the branch will come from the utilization of nanotechnology, as supposed "Smart Coatings"

Industrial Benefits Through Nanotechnology

Nanoparticles, considered "another" word in the mid 2000, has become a traditional specialized term, part of standard instructing in colleges and very much incorporated in ordinary language. Nanoparticle research has discovered its situation as a perceived discipline, thus, we anticipate that the field should keep flourishing, with significantly more fuel as nanoparticles are currently internationally accessible to labs like our more customary compound reagents.

Nano-Coatings

In recent years modern techniques have been developed to visualize and scientifically describe nano-scale materials and structures. It is therefore now possible to tailor the manufacture and use of nanomaterials and nanostructures in the coating industry to the specific needs of the various applications

Pigments-

Small, chemically inert particles have been prominently used in pigments, polymer fillers and surface finishing next to bulk applications such as ceramics. various carbon soot pigments in cave and pottery paintings and carefully reduced iron oxide colloids as red and yellow pigments.

Anti-UV Products

More recent advances in aerosol synthesis permitted manufacturing of nanoparticles. They permits strong optical effects and high color depth. After recognizing the estrogen-like activity of numerous organic sunscreen additives, inorganic UV absorbing pigments based on nanoparticles. [6,7]

Antimicrobial Agents

The traditional use of certain metals against microorganisms has been known for several millennia. The possibility, however, to prepare metals in the form of very small particles, and reliably spread them over large consumer surfaces, has provided an astonishing revival in interest around these antimicrobial agents

"Nanomaterials can be modified to improve the overall characteristics of convectional materials because of their tiny size. Nanotechnology has also aided in the development of more efficient and long-lasting materials. Steel, glass, and nanotechnology-based coatings are used to protect the layers against corrosion."[4,8]

The thoughts and ideas driving Nano Science and nanotechnology began with a discussion named "There's Plenty of Room at the Bottom" by physicist Richard Feynman at an American Physical Society meeting at the California Institute of Technology on December 29, 1959, some time before the term nanotechnology was utilized.[9,10]

Future scope of Nanotechnology in Coatings & Paint Industry

Scratch – resistant

Nanopolymer coatings applied over car paint can reflect heat to regulate temperature and make air conditioners more fuel-efficient. Ceramic nanoparticles-infused paints can protect cars against minor scratches, and nanopolymer coatings applied over car paint can reflect heat to regulate temperature and make air conditioners more fuel-efficient.

ANTI- MICROBIAL

Antimicrobial, antifungal, and antibacterial biocides are predicted to become more common as buildings and industries are expanding. Biocides in paint inhibit the growth of fungus, algae, and bacteria, all of which may be highly damaging to painted surfaces therby providing an Anti-microbial coating to the surfaces.

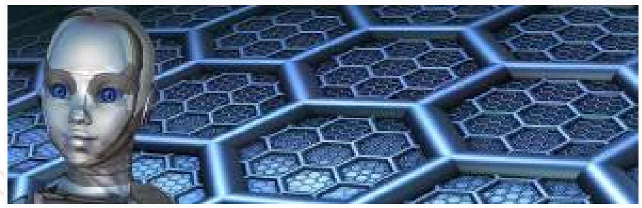
WEATHER- RESISTANT

Any solvent's chemical composition can be improved with nanomaterials. They are usually only applied in trace amounts to a coating substance. They may change a wide range of qualities in the coating material, such as flow behaviour, surface tension, gloss, structure, UV and weather resistance, and so on.

RESULTS

Latest Research topics in Polymers and Chemicals sector

The latest trend in Chemical & Polymer is more about Smart Material, Sustainable Construction, and Energy Efficient Structures and thus, redefining their roles as Innovators.



A New Method to Create Luminescent Graphene

Graphene is more elastic than rubber, harder than a diamond, lighter than aluminium, tougher than steel, and tougher than steel. These are only a few of the characteristics of this amazing material, which is a great electrical and heat conductor.

Carbonitride Aerogels Facilitate Photocatalytic Conversion of Water

Researchers have developed a macroscopic aerogel made of carbonitride nanoparticles that is an excellent catalyst for the water-splitting reaction when exposed to visible light. The research, which was published in the journal Angewandte Chemie, opens up new possibilities for melamine-derived carbonitrides material characteristics.

Environmentally Friendly Method to Make Nanoclusters of Zinc Peroxide
A team of researchers from Aalto University in Finland developed anticancer nanomaterials by modelling the deep ocean's dynamic chemistry caused by volcanoes.

Nanomaterial for Efficient Harvesting of Sunlight
Sunlight can be used more efficiently in the future with the use of nanomaterials to activate chemical reactions like artificial photosynthesis.

Simple Chemical Method Transforms Crystal Mixture
A team lead by experts at the Lawrence Berkeley National Laboratory (Berkeley Lab) of the US Department of Energy discovered a way to make a liquid-like condition behave more like a solid and then reverse the process.

Biomimetic Nanotechnology for Water Purification
Freshwater bodies have become unsuitable for drinking as a result of the industrial revolution, consequent pollution, and climate change. Various water treatment technologies have been developed to help with this issue. [11,12]

CONCLUSIONS
The traditional chemical industry has become a largely mature industry with many commodity products based on established technologies. Therefore, new product and market opportunities will more likely come from speciality chemicals, and from new functionalities obtained from new processing technologies as well as new microstructure control methodologies. It is a well-known fact that in addition to its molecular structure, the microstructure of a material is key to determining its properties. [13,14] Controlling structures at the micro- and nano-levels is therefore essential to new discoveries. For this article, we define nanotechnology as the controlled manipulation of nanomaterials with at least one dimension less than 100nm. Nanotechnology is emerging as one of the principal areas of investigation that is integrating chemistry and materials science, and in some cases integrating these with biology to create new and yet undiscovered properties that can be exploited to gain new market opportunities. In this article market opportunities for nanotechnology will be presented from an industrial perspective covering electronic, biomedical, performance materials, and consumer products. Manufacturing technology challenges will be identified, including operations ranging from particle formation, coating, dispersion, to characterization, modeling, and simulation. Finally, a nanotechnology innovation roadmap is proposed wherein the interplay between the development of nanoscale building blocks, product design, process design, and value chain integration is identified. A suggestion is made for an R&D model combining market pull and technology push as a way to quickly exploit the advantages in nanotechnology and translate these into customer benefits.[15]

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