



Recent
Advancements in
NANOTECHNOLOGY
Current Trends and Future Scope



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RECENT ADVANCEMENTS IN NANOTECHNOLOGY

Current Trends and Future Scope

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Shazia Mansoor, Zeeshan Rafi, Tabrez Faruqui,
Salman Khan

Chapter 1

INTRODUCTION TO NANOTECHNOLOGY

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SUMMARY

As a broad phrase, "nanotechnology" encompasses a wide range of fields in the sciences, technology, and engineering. When it comes down to it, it's all about working with small things. The study, design, manipulation, production, and control of materials or devices by physical or chemical means at resolutions on the order of one-billionth of a metre defines the nanotechnological research area. There are numerous uses for nanotechnology, which necessitates a grasp of its principles. This chapter provides an overview of nanotechnology and explores its potential influence on human lifestyle in the near future.

Keyword: Nanoscale, quantum size effect, fullerene, nanobiotechnology

1. Introduction

Nanotechnology is a rapidly emerging growing field with its applications in science and technology (Albrecht *et al.* 2006). The

Chapter 2

PROPERTIES OF NANOMATERIALS

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SUMMARY

Current chapter begins with a bird's eye view of the field of nanoscience and nanotechnology and their significance to different fields of science, covering from its history to the latest development.

This chapter proceeds to describe different physical, chemical and biological routes of nanoparticles synthesis. Further different characterization, drug conjugation and functionalization techniques were discussed. It also gives an account of different properties and applications of nanoparticles with particular emphasis to biological applications.

Keyword: Nanotechnology, Surface Plasmon Resonance, Quantum dots, biodiagnostics

1. Nanotechnology

Nanotechnology has created a key revolution in the 21st century, exploiting the new and challenging properties, phenomena and functions exhibited by matters when dealt at the nano level. The word

Chapter 3

SYNTHESIS OF NANOMATERIALS

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SUMMARY

Nanotechnology comprises a number of technologies and materials with varying particle sizes used in technology and research. Nanotechnology involves tiny (nano) particles. Nanomaterials' alterable physical, biological, and chemical properties have made them popular in advanced technologies. Their high surface-area-to-volume ratio gives them several advantages over traditional materials, such as improved optical clarity, higher trapping of the contained substance, and quicker action, making them appropriate for industrial applications. These particles' particular qualities make them popular in commercial and scientific settings. Food, fertilizer, biosensors, nanoelectronics, biopharmaceuticals, and biopolymers use nanotechnology. This chapter introduces nanotechnology and describes how nanomaterials are produced and used.

Keyword: Nanotechnology, Biomimetic Synthesis, Oligosaccharides, Glyconanoparticles

Chapter 4

CHARACTERIZATION OF SYNTHESIZED NANOMATERIALS

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SUMMARY

The production of materials with dimensions of less than 100 nanometers is a significant achievement for both industry and research. Nanoparticles, in contrast to their bulk counterparts, possess distinctive characteristics that make them ideally suited for use in electrical, chemical, and optical applications. Nanoparticles are attractive for a variety of applications, but the features that make them appealing also make characterisation more difficult. The challenge is in determining which methods of nanoparticle characterization are the most effective. This chapter will provide an in-depth discussion of the various strategies for characterising nanotechnology.

Keyword: Nanotechnology, Scanning Electron Microscope, Transmission Electron Microscope, Dynamic Light Scattering

Chapter 5

SURFACE FUNCTIONALIZATION OF NANOPARTICLES

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SUMMARY

Many ailments, including cancer, can be diagnosed and treated using nanoparticles (NPs). There are several drawbacks, however, such as NPs' cell toxicity and low absorption efficiency, which prevent them from being used in the therapeutic environment. Surface composition, superficial charge, size, and shape are all regarded to be important elements in the biocompatibility and uptake efficiency of these nanopatforms in terms of their biocompatibility. NPs can be modified to increase their biocompatibility and uptake efficiency by functionalization of the NP surface because of their physicochemical features. Many recent research have shown that surface modification of nanoparticles can improve biocompatibility and uptake. Additional information on commonly used methods for evaluating biocompatibility and uptake is provided in this chapter.

Keyword(s): Surface functionalization, capping agents, gold nanorods, human serum albumin

Chapter 6

ROLE OF NANOPARTICLES IN TARGETED DRUG DELIVERY

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SUMMARY

The use of nanoparticles in healthcare has grown significantly in the last several years. Biological barriers, systemic, microenvironmental, and cellular that are diverse among patient groups and disorders have been circumvented by nanoparticles. Precision treatments, in which individualised approaches have improved therapeutic efficacy, has also helped overcome this patient heterogeneity. A one-size-fits all approach to nanoparticle synthesis is still being pursued in the field. In the era of targeted therapy, nanoparticles based on lipid, polymeric, and inorganic materials may be manufactured in increasingly precise ways, allowing for more tailored medication delivery. Nanoparticle designs that have been used in both non-personalized and precision applications are discussed in this chapter.

Chapter 7

BACTERIA AND FUNGI MEDIATED BIOSYNTHESIS OF NANOPARTICLES

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Summary

In this chapter fungal strains and bacterial strains that had been isolated and characterised, all were employed to synthesise silver and neodymium nanoparticles (NdNPs). UV-Visible spectrophotometer was used to monitor the synthesis of AgNPs and NdNPs. Nd and AgNPs each had an emission band between 416-418 nm and 285-287 nm attributed to their surface plasmon resonance. Spherical and monodispersed sized nanoparticles with a range of 9-15 nm in diameter were synthesized. Furthermore, Zeta potential proved the stability of both kinds of nanoparticles.

Keywords: UV-Visible spectrophotometer, zeta-potential, dynamic light scattering, transmission electron microscopy

Chapter 8

ENZYME DERIVED SYNTHESIS, SURFACE FUNCTIONALIZATION AND BIOCONJUGATION OF INORGANIC NANOPARTICLES

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SUMMARY

For their high surface to volume ratio and extended thermal stability, metal nanoparticles are increasingly being employed in biological research and diagnostics. Because of the simplicity with which they may be synthesised, stabilised, and functionalized, as well as their low toxicity and ease of detection, gold nanoparticles (AuNPs) are an obvious choice for biological applications. A variety of chemical procedures have been utilised to synthesise AuNPs in recent years, but emerging environmentally friendly green technologies have attracted prominence. Various functionalizing moieties, including as ligands, therapeutic agents, DNA, amino acids, proteins, peptides, and oligonucleotides, can be attached to AuNPs to achieve their desired

Chapter 9

IN-VITRO CYTOTOXIC EFFECT OF BIOCONJUGATED AND BIOSYNTHESIZED NANOPARTICLES IN NORMAL AND CANCER CELL LINES

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SUMMARY

This chapter draws the conclusion that *in vivo* neoplastic transformation of mice lung by NDEA with PB promotion provides the opportunity for more research into the mechanism that leads to the formation of human lung cancer linked with the intake of tobacco products. This chapter establishes an appropriate *in vivo* method for the investigation of the neoplastic disease of the lungs.

Keyword(s): Neoplastic, lung cancer, cytotoxicity, nuclear morphology

1. Introduction

In recent years, the application of NPs in medicine had been increased and expanded to the fields of molecular imaging (Kaiser et al., 2011),

Chapter 10

***IN-VIVO* STUDY OF ENZYMATICALLY SYNTHESIZED GNPS AND MODELLING HUMAN LUNG CANCER IN SWISS ALBINO MICE**

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SUMMARY

This chapter portrays that the NDEA-PB promotion used to induce lung cancer in mice provides a model for studying human lung cancer risk factors in a more in-depth manner. The neoplastic illness of the lungs may now be studied in an in vivo environment according to this research. According to earlier chapters, it was shown that gold nanoparticles encapsulated with bromelain, which demonstrated anti-cancer potential against a variety of cell lines and particularly lung cancer cells, had an LD 50 level of 50 nM. The LD 50 dosage in this study was 25.7 mg/kg of body weight in swiss albino mice. Bromelain-encapsulated gold nanoparticles' ability to kill lung cancer cells and the determination of the LD 50 are only a few highlights of the current chapter, which was conducted in normal [non-genetically modified] Swiss albino mice.