Conference Proceedings of

Futuristic Trends, Challenges on Advanced Biomaterial Technologies for medical applications

Editors
Dr. V.A. Kinsalin
Mr. K. Mahendran
Ms. S. Sri Pavithra

Organized by
Department of Life Sciences
Apollo Arts and Science College
Poonamallee
Mevalurkuppam, Kanchipuram- 602105

APOLLO ARTS & SCIENCE COLLEGE

POONAMALLEE, CHENNAI -602 105.

NATIONAL CONFERENCE

ON

FUTURISTIC TRENDS, CHALLENGES ON ADVANCED BIOMATERIAL TECHNOLOGIES FOR MEDICAL APPLICATIONS.

FTABT-2025

20TH MARCH 2025

ORGANIZED BY

DEPARTMENT OF LIFE SCIENCES

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Editorial Board

The abstracts in this book were submitted by participants of the National Conference. They were reviewed, evaluated by the editorial board committee and were accepted for Oral Presentations.

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APOLLO ARTS & SCIENCE COLLEGE
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PRINCIPAL MESSAGE

I am happy to note that our department of LIFE SCIENCES are organizing a NATIONAL CONFERNECE on “FUTURISTIC TRENDS, CHALLENGES ON ADVANCED BIOMATERIAL TECHNOLOGIES FOR MEDICAL APPLICATIONS” scheduled on 20th March 2025.

I am grateful that the deliberation of this National Conference would, in some way, serve as a vision document that would suggest solutions to the challenges faced in the fields of biomaterials. I am happy to congratulate the respective departments heads and faculties for making available yet another platform for the students, faculties and research scholars to learn and discuss about the information during the conference.

I wish the National Conference a great success!!!

PRINCIPAL

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Dr. SURENDRA NIMESH
UGC Asst Prof,
Dept of Biotechnology,
Central University of Rajasthan, India.

Keynote address

Conventional treatment modalities consists of chemically synthesized drug molecules. These molecules have been successfully employed for the treatment of several diseases, including bacterial and viral infections. However, these routine drug delivery methods may lead to many limitations including poor distribution, limited effectiveness, lack of selectivity and dose dependent toxicity etc. An efficient drug delivery system can surmount these issues. Development of a vector for the delivery of therapeutic drug in a controlled and targeted fashion is still a major challenge in the treatment of many diseases. Recent progress towards advancement of nanotechnology in biomedical field has the potential to circumvent these challenges in drug delivery system. Nanomaterials are changing the biomedical platform in terms of disease diagnosis, treatment and prevention. Nanomaterials aided delivery of drug provides advantage by enhancing aqueous solubility that leads to improved bioavailability, increased resistant time in the body, decreased side effects by targeting the drug to the specific location, reduced dose dependent toxicity and protection of the drug from early release. Owing to their interesting physicochemical properties such as smaller size, larger surface area, electrical, optical and magnetic properties, nanomaterials are being sought in a wide range of applications including technology, cosmetics, food packaging, medical imaging and drug delivery. Carbon nanotubes (CNTs), quantum dots, mesoporous and amorphous nanosilica, nanosilver, nano titanium and zinc oxides are some of the nanomaterials currently in commercial use. Physicochemical studies is an important aspect and need to be emphasized upon to discuss the different analytical methods to assess morphology, surface functionalities, behavior in solution, stability, etc. Toxicity studies is a critical component for the selection of safer nanomaterials for application in drug delivery and to meet regulatory standards. To sum up, nanomaterials are a promising and safe candidate with enormous potential in disease diagnosis and treatment.

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CHIDAMBARAM, TAMIL NADU, INDIA

Dr. S. SENTHILVELAN
Associate Professor
Department of Chemistry

MESSAGE

*I am very happy to note that the Department of Life Sciences, Apollo Arts and Science College, Poonamallee is organizing a National Conference on **"Futuristic Trends, Challenges on Advanced Biomaterial Technologies for Medical Applications"** during March-20, 2025. It gives me immense pleasure to record at this juncture, the study growth of life sciences departments for the past few years. This has been possible due to devotion and hard work put in by the faculty members and highly responsive and innovative management.*

I congratulate the Conveners for their meticulous planning and careful organizing the National conference. I am sure this conference will be an occasion for exchange of new ideas among the experts in this field and also for other participants to learn new techniques.

I wish the National conference a grand success.

Date: 15.3.25 (Dr. S. SENTHIL VELAN)

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PROGRESS THROUGH KNOWLEDGE

Dr. D. Durgalakshmi
Assistant Professor

Date: 13.03.2025

To the Participants and Organizers,

It is a distinct honour to address you as an invited speaker at the National Conference on "**Futuristic Trends, Challenges on Advanced Biomaterial Technologies for Medical Applications**", hosted by the **Department of Life Sciences, Apollo Arts and Science College, Chennai, India**. The focus on cutting-edge biomaterials and their medical applications is both timely and crucial. I eagerly anticipate sharing my insights and engaging in discussions that will explore the innovations and challenges shaping this dynamic field. This conference provides a vital platform to foster collaboration, bridge the gap between research and practical application, and ultimately advance patient care.

I commend the Department of Life Sciences for creating this essential forum for knowledge exchange. I am confident that the diverse presentations and discussions will inspire groundbreaking advancements and pave the way for future innovations in biomaterials. I look forward to a stimulating and insightful conference where we can collectively contribute to the progress of medical technologies.

D. DURGALAKSHMI

Dr. D. DURGALAKSHMI, PhD
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Department of Medical Physics
Anna University,
Chennai, 600 025, INDIA.

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Programme Schedule

(9.30 AM): INAGURAL CEREMONY
TAMIL THAI VAZHTHU

(9.35 AM): LIGHTING OF THE LAMP

(9.40 AM): WELCOME ADDRESS
DR. S. SUTHAKAR, PRINCIPAL

(9.45 AM): FELICITATION OF DIGNITARIES

(9.50 AM): INTRODUCING THE CHAIR PERSON
- (DR.V.A. KINSALIN, Head, Dept of Biotechnology)
Dr. SURENDRA NIMESH

TOPIC: NANOMATERIALS FOR ENHANCED DIAGNOSIS AND THERAPY

(10:45 AM): INTRODUCING THE KEYNOTE SPEAKER I
- (MS. S. SRI PAVITHRA, Head, Dept of Microbiology)
DR. DURGALAKSHMI DHINASEKARAN

TOPIC: THE PERSPECTIVE ON THE PRESENT AND FUTURE OF BIOSENSORS.

(11.30 AM): INTRODUCING THE KEYNOTE SPEAKER II
- (DR.V.A. KINSALIN, Head, Dept of Biotechnology)
Dr. S. SENTHIL VELAN
TOPIC: NEW AGE NANOMATERIALS: RECENT DEVELOPMENTS AND NEW DIRECTIONS

(12.20 PM): ORAL/POSTER PRESENTATIONS

(12.50 PM): VALEDICTORY -ALL THE DIGNITARIES

(1.00 PM): VOTE OF THANKS
- (MR. K. MAHENDRAN, Head, Dept of Physics)

(1.20 PM): NATIONAL ANTHEM

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ABOUT THE COLLEGE

Apollo educational group is a prestigious group which made a significant contribution to impart education for our students. Apollo arts & Science College is affiliated to the University of Madras and offers 20 courses across of 9 streams, namely science, medical, paramedical, education, vocational, IT, commerce and Banking. The college imparts higher education with integral formation which involves academic excellence and spiritual growth. The college boasts with good infrastructural and has 3300 students guided by more than 120 faculties. Education extolled everywhere – true to this motto of our college the students of our group institutions have placed in respectable and lucrative jobs in various esteemed establishment.

ABOUT LIFE SCIENCES DEPARTMENT

The departments of life sciences were established in the year 2016. It offers U.G and other programmes. It boosts of well qualified faculty, good infrastructure and well-equipped laboratories with sophisticated instruments. The departments regularly conduct symposia and workshops. In additional to this, it organizes guest lectures by eminent scientists so that student get a first knowledge of the cutting-edge research being carried out in the fields of Life Sciences. It encourages students to carry out research projects and motivates them to present and publish research outcomes.

ABOUT THE CONFERENCE

The national conference on Futuristic Trends, Challenges on Advanced Biomaterial Technologies for medical applications, 2025 to be organized by the department of life sciences, Apollo Arts and Science College, poonamallee, Chennai. The main intention of this conference is to reflect the pioneering state of Biomaterials and its medical applications. The national conference aims to bring students to exchange and share their experiences, new ideas and research perspectives about all aspects of Biomaterials and discuss the practical challenges encountered and the solutions adopted.

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INVITED TALK

1. TECHNICAL SESSION – I

Dr. SURENDRA NIMESH
UGC Asst Prof,
Dept of Biotechnology,
Central University of Rajasthan, India.

2. TECHNICAL SESSION – II

DR. DURGALAKSHMI DHINASEKARAN
Assistant Professor,
Department of Medical Physics,
Anna University, Chennai.

3. TECHNICAL SESSION – III

Dr. S. SENTHIL VELAN
Associate Professor,
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REVOLUTIONIZING TISSUE ENGINEERING: NANOTECHNOLOGY IN BIOPRINTING

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Abstract

Bioprinting has emerged as a promising technology for creating functional tissue substitutes, offering unprecedented opportunities for regenerative medicine and tissue engineering. The integration of nanotechnology with bioprinting has further enhanced the field, enabling the creation of complex tissue structures with precise control over cellular microenvironments. This review highlights the recent advances in nanotechnology-enabled bioprinting, focusing on the development of nanostructured biomaterials, bioinks, and microfabrication techniques. The incorporation of nanoparticles, nanofibers, and nanotubes into bioprinted constructs has been shown to improve their mechanical properties, cellular adhesion, and bioactivity. Moreover, nanotechnology has enabled the creation of complex tissue architectures, including vascular networks and stem cell niches. We discuss the current challenges and future directions in this field, including the need for standardized nanomaterials, improved bioprinting resolution, and enhanced tissue maturation strategies. The convergence of nanotechnology and bioprinting has the potential to revolutionize tissue engineering, enabling the creation of functional tissue substitutes for a wide range of applications, from organ transplantation to wound healing.

Keywords: *Bioprinting, Nanotechnology, Tissue engineering, Regenerative medicine, Nanostructured biomaterials, Bioinks, Microfabrication*

TITLE: ADVANCES IN SEMICONDUCTING MATERIALS: ENHANCING PERFORMANCE AND SUSTAINABILITY

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Abstract

Semiconducting materials have revolutionized modern technology, enabling the development of smaller, faster, and more efficient electronic devices. This paper presents a comprehensive review of recent advances in semiconducting materials, focusing on their enhanced performance, sustainability, and applications. We discuss the latest developments in semiconductor technology, including the emergence of new materials, such as graphene, transition metal dichalcogenides (TMDCs), and perovskites. These novel materials exhibit exceptional electronic and optical properties, offering improved performance, flexibility, and scalability. We also explore the integration of semiconducting materials with other technologies, such as nanotechnology, biotechnology, and renewable energy. Furthermore, we address the environmental and societal implications of semiconductor production and disposal, highlighting the need for sustainable and responsible practices. The advancements in semiconducting materials have far-reaching implications for various industries, including energy, healthcare, transportation, and communication. As the demand for smaller, faster, and more efficient devices continues to grow, the development of novel semiconducting materials will play a crucial role in shaping the future of technology.

Keywords: *Semiconducting materials, Nanotechnology, Graphene, Transition metal dichalcogenides (TMDCs), Perovskites, Sustainable electronics*

NANO-SCALE PROCESSES IN THE ENVIRONMENT

s. Abdul Rasheed[1], R. Niranjan Kumar[2], Dr. Jayalakshmi. N [3*]
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Abstract

The advent of nanotechnology has opened up new avenues for understanding and addressing environmental challenges at the molecular level. Nano-scale processes play a critical role in shaping the behaviour and interactions of materials in the environment. These processes, which occur at dimensions of 1 to 100 nanometers, influence various environmental phenomena such as pollutant transport, bioaccumulation, and the degradation of organic and inorganic compounds. At the nano scale, the increased surface area-to-volume ratio of materials significantly enhances their reactivity, enabling them to interact more efficiently with their surroundings. Nanomaterials, both natural and engineered, have shown promise in applications such as water treatment, soil remediation, and energy harvesting, offering sustainable solutions for environmental protection. However, understanding the potential risks associated with the release of nanoparticles into ecosystems is essential to ensure the safety and efficacy of these technologies. These abstract aims to explore the fundamental nano-scale processes that govern environmental interactions, highlighting both their benefits and challenges in terms of environmental sustainability.

Keywords: *Nano-scale processes, nanotechnology, environmental interactions, pollutant transport, bioaccumulation, surface area-to-volume ratio, nanomaterials, sustainability, water treatment, soil remediation.*

MATERIALS FOR BIOLOGICAL APPLICATIONS: DESIGN, DEVELOPMENT, AND TRANSLATION

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Abstract

The development of materials for biological applications has revolutionized the field of biomedicine, enabling the creation of innovative medical devices, diagnostic tools, and therapeutic platforms. This abstract highlight recent advances in the design, development, and translation of materials for biological applications, including biomaterials, nanomaterials, and biohybrid materials. Recent breakthroughs in materials science have enabled the creation of materials that can interact with living systems, modulate biological responses, and promote tissue regeneration. These materials have been designed for a range of applications, including tissue engineering, wound healing, drug delivery, and diagnostic imaging. The translation of these materials into clinical and commercial applications requires a multidisciplinary approach, involving materials scientists, engineers, biologists, and clinicians. This abstract discusses the current state of the field, highlighting successful examples of materials-based solutions for biological applications, and outlining the challenges and opportunities for future research and development.

Keywords: *biomaterials, nanomaterials, biohybrid materials, tissue engineering, wound healing, drug delivery, diagnostic imaging*

TITLE: NANO-ENGINEERED BIOHYBRID SYSTEMS FOR ENHANCED BIOREMEDIATION AND SUSTAINABLE ENVIRONMENTAL MANAGEMENT

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Abstract

Environmental pollution finds a significant threat to ecosystems and human health, necessitating innovative solutions for efficient bioremediation. This study presents a novel approach by designing Nano-engineered biohybrid systems that integrate living cells with nanomaterials, enhancing bioremediation capabilities. By leveraging the unique properties of nanomaterials, such as high surface area and reactivity and the metabolic versatility of microorganisms, our biohybrid systems facilitate the efficient degradation of pollutants and toxins. The designed biohybrid systems exhibit Improved bioremediation efficiency, stability, and reusability, making them a promising solution for sustainable environmental management. This research demonstrates the potential of Nano-engineered biohybrid systems for the removal of various pollutants, including heavy metals, pesticides, and industrial contaminants. Furthermore, our findings highlight the importance of optimizing Nano-bio interfaces to enhance bioremediation performance. The development of Nano-engineered biohybrid systems offers a sustainable and eco-friendly solution for environmental management, enabling the restoration of polluted ecosystems and promoting a healthier environment. This research has significant implications for the development of novel bioremediation technologies and provides a foundation for future studies on nano-bio interfaces and their applications in environmental sustainability.

Keywords: - *Nano-engineered biohybrid systems, Bioremediation, Sustainable environmental management, Nanomaterials, Microbial biotechnology, Environmental pollution*

NANOMATERIALS FOR BIO-REMEDIATION

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Abstract

Bioremediation is an environmentally sustainable process that utilizes microorganisms or plants to detoxify and remove pollutants from contaminated environments. In recent years, the integration of nanomaterials into bioremediation strategies has emerged as a promising approach for enhancing the efficiency and effectiveness of pollutant removal. Nanomaterials, due to their unique properties such as high surface area, reactivity, and ease of functionalization, can significantly improve the bioavailability of contaminants, facilitate their degradation, and promote the growth and activity of microorganisms involved in bioremediation. This review explores the various types of nanomaterials, including nanoparticles, nanocomposites, and nanotubes, and their applications in bioremediation of organic and inorganic pollutants such as heavy metals, pesticides, and hydrocarbons. The role of nanomaterials in enhancing microbial activity, accelerating biodegradation processes, and supporting nutrient cycling is discussed in detail. Additionally, the interaction between nanomaterials and microorganisms, as well as their potential for improving the efficacy of bioremediation under challenging environmental conditions, is addressed. Despite the promising applications, concerns regarding the toxicity and environmental impact of nanomaterials, as well as the scalability of these technologies, remain a critical challenge.

Keywords: *Bioremediation, nanomaterials, nanoparticles, biodegradation, heavy metals, microorganisms*

NANOCOMPOSITES: DESIGN, SYNTHESIS, AND APPLICATIONS OF MULTIFUNCTIONAL MATERIALS

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Abstract

Nanocomposites have emerged as a new class of materials that combine the benefits of nanotechnology with the versatility of composite materials. These hybrid materials exhibit unique properties that arise from the interactions between their constituent phases, enabling the creation of multifunctional materials with tailored properties. This review highlights the recent advances in nanocomposite design, synthesis, and applications, focusing on the development of new fabrication techniques, the optimization of interfacial properties, and the exploration of novel applications. The integration of nanoparticles, nanotubes, or nanosheets into polymer, ceramic, or metal matrices has been shown to enhance mechanical, thermal, electrical, and optical properties, enabling the creation of advanced materials for a wide range of applications, including energy storage, catalysis, sensing, and biomedical devices. We discuss the current challenges and future directions in nanocomposite research, including the need for scalable synthesis methods, improved interfacial control, and enhanced understanding of structure-property relationships. The development of nanocomposites has the potential to transform various industries, from energy and aerospace to healthcare and consumer products, by enabling the creation of materials with unprecedented properties and functionalities.

Keywords: *Nanocomposites, Multifunctional materials, Nanoparticles, Nanotubes, Polymer matrix composites, Ceramic matrix composites, Metal matrix composites.*

BIOLOGICAL AND ANTIBACTERIAL INSIGHTS INTO TITANIUM-BASED NANOCOMPOSITE IMPLANTS

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Abstract

The clinical preference for Titanium (Ti) implants stems from their combination of strength along with good biocompatibility yet they encounter important challenges when infections develop with biomaterials specifically in dental and orthopedic fields. The research explores the creation and examination of Ti specimens where AgNPs were incorporated by using human serum albumin (HSA) and glutathione (GSH) as biomolecular templates to achieve antibacterial properties with preserved cyto-compatibility. The researchers used a single-step aqueous method to modify titanium surfaces by adjusting the ratios of biomolecule to silver. The laboratory work used FTIR and SEM to show both the successful synthesis of AgNPs and their modified surface status. In vitro testing showed Ag particles released in a controlled manner so the maximum concentration of 3.51 ppm reached after seven days which indicates their capacity to maintain antibacterial effectiveness. The antibacterial tests on *Staphylococcus aureus* showed significant decreases in bacterial attachment and biofilm growth on modified surface specimens particularly at optimal AgNP concentrations. The cytocompatibility results showed only minor cytotoxic impact on lower Ag content specimens which led to increased osteoblast cell growth and differentiation as measured by alkaline phosphatase activity. The research demonstrates that AgNPs enhanced with HSA and GSH show promise as Ti implant coatings because they reduce the risk of infection without compromising biological tissue response patterns which provides an innovative approach to extend the lifespan of medical implants.

Keywords: *AgNPs (Silver Nanoparticles), Titanium (Ti) implants, Human Serum Albumin (HSA), Staphylococcus aureus, Biomaterial infection (BAI)*

LUMINESCENT MATERIALS AND ITS APPLICATIONS

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Abstract

Luminescent materials are substances that absorb energy and then emit it as light. Luminescence is a spontaneous emission of radiation from an electronically or vibrationally excited species not in thermal equilibrium with its environment. A luminescent object emits cold light in contrast to incandescence, where an object only emits light after heating. Generally, the emission of light is due to the movement of electrons between different energy levels within an atom after excitation by external factors. However, the exact mechanism of light emission in vibrationally excited species is unknown. Applications- Light-emitting diodes (LEDs) emit light via electro-luminescence.Phosphors, materials that emit light when irradiated by higher-energy electromagnetic radiation or particle radiation. Luminescence occurs in some minerals when they are exposed to low-powered sources of ultraviolet or infrared electromagnetic radiation (for example, portable UV lamps) at atmospheric pressure and atmospheric temperatures. This property of these minerals can be used during the process of mineral identification at rock outcrops in the field or in the laboratory. Types- Ionoluminescence, a result of bombardment by fast ions. Radioluminescence occurs as a result of bombardment by ionizing radiation. Electroluminescence, a result of an electric current passed through a substance. Cathodoluminescence occurs as a result of a luminescent material being struck by electrons. Chemiluminescence, the emission of light occurs as a result of a chemical reaction. Bioluminescence occurs as a result of biochemical reactions in a living organism.

key words: Luminescent, Radio, Cathode and Chemical luminescence, Light emitting diode, Incandescence, Bioluminescence.

NANOTECHNOLOGY IN AGRICULTURE

Kaviyavarshini.S [1], Yeshwanth[2]. R /Dr. N. Jayalakshmi[3*]
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Abstract

Nanotechnology as gained in intense attention in the recent year due to its wide application in sereval areas like medicine medical drugs catalyse energy and materials dos nanoparticles with small size to large surface area 1 to 100 NM have seraval potential functions these days sustainable agriculture is needed the development of nanochemicals as appeared as promising agent for the plant growth Fertilizer and pesticides in recent year the use nano particles has been considered as an alternatives solution to control plant paste including insects fungi and weeds Nanomaterials have received considerable attention in the field of agrochemicals due to their special properties such as particle size surface structure solubility and chemical composition. The application of Nano material and Nanotechnology in agrochemical dramatically overcome the defect of conventional agrochemicals including low bioavailability easy photo lysis and organic solvent pollution Nanomaterials in other agrochemical such as biopesticides nucleic acid pesticides plan growth leg regulators (PGRs) and pheromone and also industrial trend of Nanomaterials in the field of argochemicals. The nanotechnology improvement of stability and Dispersion of active ingredients It promote the precious delivery of agrochemicals and reduce radius shell pollution and decrease labor cost

Keyword**: Biopesticides, fertilizer, plant growth regulators, agrochemicals, soil ersio**n

NANOMATERIALS AND THEIR MULTIFACETED APPLICATIONS: ADVANCEMENTS, CHALLENGES, AND FUTURE PROSPECTS

Mr. K. DHIYANESH[1], Mr. G. TAMILSEPVAN[2], Mrs. SUMITHRA[3]
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Abstract

Nanomaterials have emerged as a transformative force across multiple scientific disciplines, offering groundbreaking advancements in medicine, environmental science, and material engineering. Their unique physicochemical properties enable precise control over biological and chemical interactions, making them highly effective in applications such as Nano drugs, bio sensing, bioremediation, and nanofabrication. In the medical field, nanotechnology has revolutionized drug delivery by allowing targeted therapy, controlled drug release, and reduced systemic toxicity, significantly improving treatment outcomes for conditions like cancer and neurodegenerative diseases. Additionally, Nano medicine plays a crucial role in diagnostics, personalized treatment, and regenerative medicine. In environmental science, nanomaterials facilitate pollutant degradation, water purification, and sustainable agricultural practices, supporting green revolution strategies and ecosystem restoration. Moreover, the integration of nanoscale processes in materials science has led to the development of advanced polymer Nano composites, luminescent materials, crystalline structures, and semiconductors, all of which have diverse applications in electronics, energy storage, and high-performance devices. Nanotechnology-based sensors have further enabled real-time monitoring and diagnostics in healthcare, industrial automation, and environmental surveillance, enhancing accuracy and efficiency.

Keywords: *Nanomaterials, Green revolution, Nano drugs, Bioremediation, Nano medicine, Nanotechnology, Sensors, Polymer Nano composites, Crystalline materials, Semiconducting materials.*

NANO MATERIALS BASED – APPLICATION FOR MEDICINE

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Abstract

Nanotechnology is the treatment of individual atoms, molecules, on Compounds into structures to produce materials and devices with Special, properties, Nanomaterials-natural, accidental, or engineered-occur in the air, water, or soil. Natural nanoparticles are generally found in a wide range of Environments, such as natural water, sediments, weathered minerals and rocks, and Volcanic ash. Nano medicine is a relatively new field of science and technology. Brief explanation of various types of pharmaceutical nano systems is given. Classification of nano materials based on their dimensions is given. An application Of Nanotechnology in various fields such as health and medicine, electronics, energy and environment, is discussed in detail. Applications of nano particles in Drug delivery, protein and peptide delivery, cancer are explained. Applications of Various nano systems in cancer therapy such as carbon nano tube, dendrimers, nano crystal, nano wire, nano shells etc. Are given. The advancement in nano Technology helps in the treatment of neuro degenerative disorders such as Parkinson's disease and Alzheimer's disease. Applications of nano technology in Tuberculosis treatment, the clinical application of nanotechnology in operative Dentistry, in ophthalmology, in surgery, visualization, tissue engineering, antibiotic Resistance, immune response are discussed in this article. Nano pharmaceuticals Can be used to detect diseases at much earlier stages

Keywords: *Tissue engineering, Antibiotic resistance, ophthalmology, pharmaceutical*

EXPLORING THE NANO MATERIAL BASED APPLICATION FOR MEDICINE

Pushpalatha.J[1]..,Thamara selvi.D[2]..,Nandhini.B[3].., Nancy[4*]
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Abstract

Nanotechnology has extensive application has Nano medicine in the medical field some Nano particles has possible application in the field. Today treatment of high toxicity can be administered with the improved safety nusing Nanotechnology such as chemotherapeutic cancer drugs. For caring out this study, relevant papers on nanotechnology in the medical fields from Scopus, Google scholar. Research gate and other research platforms are identified and studied Nano medicine is a relatively new field of science and technology. An application of Nano technology in various fields such as health and medicine, based on this dimension is given an application of Nano technology in various fields drug delivery, protein and peptide delivery. Cancer are explained, applications of Nano technology in tuberculosis treatment the clinical application of Nano technology in operative dentistry in ophthalmogy is surgery. Visualization tissue engineering antibiotics resistance, immune response are discussed in this articles. Nano pharmaceuticals can be used to detect disease at much earlier stage. The article aims to summarise the current application of Nanomaterials in medicine, delving into an in-depth exploration and summary of four specific

Keywords: *n*anotechnology, Application, Toxicity, Chemotherapeutic, drugs, Research, dimensions, Pharmaceutical.

NANOTECHNOLOGY AND SENSORS

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Abstract

Nanotechnology has revolutionized the development of sensors by enabling the creation of highly sensitive, miniaturized, and efficient devices for a wide range of applications. The integration of nanomaterials, such as nanoparticles, nanowires, and carbon-based materials, with sensor technologies has enhanced their performance in detecting chemicals, gases, biomolecules, and environmental changes. This interdisciplinary field is particularly significant in applications such as medical diagnostics, environmental monitoring, and industrial automation, where real-time, high-precision data is essential. The unique properties of nanomaterials, including increased surface area, improved conductivity, and functionalization potential, allow sensors to detect low concentrations of analytes with high specificity. Moreover, advancements in nanofabrication techniques and the development of flexible, wearable, and wireless sensors have paved the way for the next generation of smart systems. Despite the promising potential, challenges in scalability, stability, and integration remain critical areas for further research.

Keywords*: Nanotechnology, Sensors, Nanomaterials, Nanoparticles, Nanowires, Biomedical applications.*

NANOFABRICATION UNCONVENTIONAL

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Abstract

The scientific effort toward achieving a full control over the correlation between structure and function in organic and polymer electronics has prompted the use of supramolecular interactions to drive the formation of highly ordered functional assemblies which have been integrated into real devices. In the resulting field of supramolecular electronics self-assembly of organic semiconducting materials constitutes a powerful tool to generate low dimensional and crystalline functional architectures. Nanostructures are fabricated using either conventional or unconventional tools that is by techniques that are highly developed and widely used or by techniques that are relatively new and still being developed. This chapter reviews techniques of unconventional nanofabrication and focuses on experimentally simple and inexpensive approaches to pattern features with dimensions <100 nm. A particular focus is put on how single and multiple supramolecular fibers and gels as well as supramolecularly engineered 2D materials can be integrated into novel vertical or horizontal junctions to realize flexible and high-density multifunctional transistors, photodetectors, and memristors, exhibiting a set of new properties and excelling in their performances.

Keywords: *nanofabrication; optoelectronic devices; organic crystalline; supramolecular electronic; scanning probe lithography, soft lithography.*

GROWTH AND FORMATION OF CRYSTALLINE MATERIALS

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Abstract

Crystalline materials are solids characterized by a highly ordered atomic structure, where atoms, ions, or molecules are arranged in a repeating, three-dimensional pattern known as a crystal lattice. This periodic arrangement gives rise to unique physical, chemical, and mechanical properties, such as anisotropy, hardness, and optical transparency. Crystalline materials are classified into several types, including ionic crystals, covalent crystals, metallic crystals, and molecular crystals, each with distinct bonding and structural features. The study of crystalline materials is fundamental to materials science, as their properties are influenced by factors such as crystal symmetry, defects, and grain boundaries. Techniques like X-ray diffraction (XRD) and electron microscopy are commonly used to analyze their structure. Crystalline materials have wide-ranging applications, from semiconductors in electronics to piezoelectric materials in sensors and structural materials in engineering. Advances in crystallography and nanotechnology have enabled the design of novel crystalline materials with tailored properties for specific applications, such as energy storage, catalysis, and photonics. Understanding the relationship between atomic structure and material properties remains a key focus in the field, driving innovations in technology and industry.

Keywords: *Crystalline materials, crystal lattice, anisotropy, X-ray diffraction (XRD), crystal symmetry, defects, grain boundaries, semiconductors, piezoelectric materials.*

NANOCOMPOSITES IN POLYMERS

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Abstract

Polymer nanocomposites (PNCs) are advanced materials the combine polymers with nanoscale fillers, such as nanoparticles, nanoclays, carbon nanotubes, or graphene, to enhance their mechanical, thermal, electrical, and barrier properties. The incorporation of nanofillers into polymer matrices results in a significant improvement in performance, even at low loading levels (typically 1-5 wt%), due to their high surface area and unique nanoscale effects. PNCs are widely used in various industries, including automotive, aerospace, packaging, electronics, and biomedical applications, owing to their lightweight, durability, and multifunctionality. The properties of PNCs depend on factors such as the type of polymer, nanofiller, dispersion quality, and interfacial interactions between the matrix and filler. Challenges in the development of PNCs include achieving uniform dispersion of nanofillers, preventing agglomeration, and ensuring strong interfacial adhesion. Recent advancements in processing techniques, such as in-situ polymerization, melt blending, and solution mixing, have enabled better control over the microstructure and properties of PNCs. Emerging trends in PNC research focus on sustainable and biodegradable polymers, functional nanocomposites for smart applications, and the integration of artificial intelligence for material design. This review highlights the fundamental aspects, recent progress, and future prospects of polymer nanocomposites, emphasizing their potential to address modern engineering challenges and contribute to the development of next-generation materials.

Keywords: *Polymer nanocomposites, nanofillers, mechanical properties, thermal properties, electrical properties, dispersion, interfacial adhesion, physics, technology.*

BIOLOGICAL APPLICATIONS OF NANOMATERIALS

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Abstract

Materials for biological applications have revolutionized the fields of medicine, biotechnology, and environmental science. These materials, often designed with biocompatibility, biodegradability, and functionality in mind, are tailored to interact with biological systems for therapeutic, diagnostic, or regenerative purposes. Key categories include biomaterials for tissue engineering, drug delivery systems, biosensors, and implantable devices. Natural polymers such as collagen, chitosan, and hyaluronic acid are widely used due to their biocompatibility and biodegradability, while synthetic polymers like polylactic acid (PLA) and polyglycolic acid (PGA) offer tunable mechanical and chemical properties. Additionally, advancements in nanotechnology have enabled the development of nanomaterials with enhanced properties, such as targeted drug delivery, improved imaging, and antimicrobial activity. Composite materials, combining organic and inorganic components, further expand the possibilities for creating multifunctional platforms. The design of these materials often involves surface modification to enhance biocompatibility, reduce immune response, and promote cell adhesion. Recent trends focus on smart materials that respond to environmental stimuli, such as pH, temperature, or enzymatic activity, enabling precise control over drug release or tissue regeneration. Overall, materials for biological applications hold immense potential to address critical healthcare challenges and improve the quality of life.

Keywords: *Biomaterials, Biocompatibility, Drug Delivery, Tissue Engineering, Nanomaterials, Smart Materials, Biodegradable Polymers, Biosensors, Surface Modification, 3D Printing.*

NANODRUGS USES IN MEDICINAL FIELD

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Abstract

Nano drugs have emerged as a transformative approach in the medicinal field, offering innovative solutions for drug delivery, diagnostics, and therapeutic interventions. By leveraging nanotechnology, these drugs are designed at the nanoscale, enabling enhanced precision, bioavailability, and targeted delivery to specific cells or tissues. This minimizes off-target effects and reduces systemic toxicity, making them particularly valuable in treating complex diseases such as cancer, neurodegenerative disorders, and infectious diseases. Nano drugs utilize various nanocarriers, including liposomes, polymeric nanoparticles, dendrimers, and metallic nanoparticles, to encapsulate and deliver therapeutic agents. These carriers improve drug stability, prolong circulation time, and facilitate controlled release, ensuring optimal therapeutic outcomes. Additionally, surface modifications with ligands or antibodies enable active targeting, further enhancing drug efficacy. In diagnostics, nano drugs are integrated with imaging agents, enabling real-time monitoring of disease progression and treatment response. Despite their immense potential, challenges such as scalability, regulatory hurdles, and long-term safety concerns remain. However, ongoing research and advancements in nanotechnology continue to address these issues, paving the way for clinical translation. As the field evolves, interdisciplinary collaboration among scientists, clinicians, and industry stakeholders will be crucial to fully realize the potential of nano drugs in revolutionizing modern medicine.

Keywords: *Nano drugs, nanotechnology, drug delivery, nanocarriers, targeted therapy, bioavailability, personalized medicine, cancer treatment, diagnostics, therapeutic efficacy.*

NANOFABRICATION

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Abstract

Nanofabrication refers to the process of designing and creating structures, devices, and systems with nanometer-scale precision, typically ranging from 1 to 100 nanometers. This cutting-edge technology is pivotal in advancing various fields, including electronics, biotechnology, materials science, and energy storage. Techniques used in nanofabrication include photolithography, electron-beam lithography, nanoimprint lithography, and chemical vapor deposition, among others. These methods enable the fabrication of nanoscale components such as transistors, sensors, and nanostructured materials, which exhibit unique physical, chemical, and mechanical properties compared to their bulk counterparts. Nanofabrication holds the potential to revolutionize industries by enabling the development of more efficient and powerful devices with applications in computing, medicine, environmental monitoring, and renewable energy. However, challenges such as scaling, cost, and precision remain at the forefront of research to fully realize its potential.

Keywords; *Nanofabrication, Nanoscale precision, Nanometer-scale structures, Photolithography, Scaling challenges, Cost, Precision, Innovation in fabrication, Device development*

NANOTECHNOLOGY IN EDUCATION DEVELOPMENT

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Abstract

Nanotechnology education and workforce development are critical components in advancing the field of nanoscience and its applications across industries. As nanotechnology continues to revolutionize sectors such as healthcare, energy, electronics, and materials science, there is a growing demand for a skilled workforce equipped with interdisciplinary knowledge and hands-on expertise. Educational programs in nanotechnology aim to bridge the gap between traditional disciplines, integrating concepts from physics, chemistry, biology, and engineering to foster innovation. These programs are designed to prepare students for careers in research, development, and commercialization of nanoscale technologies. Workforce development initiatives focus on upskilling professionals, promoting lifelong learning, and addressing the evolving needs of the nanotechnology industry. Additionally, outreach programs and public engagement play a vital role in raising awareness about nanotechnology's potential and inspiring the next generation of scientists and engineers. By fostering a diverse and inclusive workforce, the nanotechnology community can drive sustainable growth and address global challenges. This abstract highlight the importance of nanotechnology education and workforce development in shaping the future of science and technology.

Keywords: Nanotechnology education, workforce development, interdisciplinary learning, nanoscience, skill development, industry collaboration, STEM education, innovation, nanotechnology applications, public engagement, diversity in STEM.

APPLICATIONS OF NANOTECHNOLOGY IN MEDICINE

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Abstract

Nanotechnology has revolutionized the field of medicine by enabling the development of advanced materials and systems at the nanoscale for diagnostic, therapeutic, and regenerative applications. Nano materials, such as nanoparticles, quantum dots, carbon nanotubes, and dendrimers, exhibit unique physical, chemical, and biological properties due to their highsurface area-to-volume ratio and tunable surface functionalities. These characteristics make them ideal for targeted drug delivery, imaging, and sensing applications. In drug delivery, nano materials enhance the solubility, stability, and bioavailability of therapeutic agents while enabling controlled release and site-specific targeting, thereby minimizing off-target effects and improving treatment efficacy. For instance, liposomes and polymeric nanoparticles are widely used to deliver chemotherapeutic agents to cancer cells, reducing systemic toxicity. In diagnostics, nano materials like gold nanoparticles and quantum dots are employed in biosensors and imaging techniques for early disease detection with high sensitivity and specificity. Additionally, nano materials play a pivotal role in regenerative medicine, where scaffolds and nanocomposites promote tissue engineering and wound healing by mimicking the extracellular matrix and stimulating cell growth. Ongoing research focuses on optimizing nano material design, surface modification, and functionalization to overcome these limitations.

Keywords: *Nanotechnology, Nano materials, Drug delivery, Diagnostics, Regenerative medicine, Targeted therapy, Biosensors, Tissue engineering.*

NANOTECHNOLOGY USED IN SENSORS FOR MEDICINE

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Abstract

Nanotechnology has revolutionized the field of medicine by enabling the development of advanced sensors with unprecedented precision, sensitivity, and functionality. These nanosensors, often fabricated at the molecular or atomic scale, are designed to detect and monitor biological and chemical processes in real-time, offering transformative applications in diagnostics, drug delivery, and personalized medicine. By leveraging the unique properties of nanomaterials, such as high surface-to-volume ratios, tunable optical and electrical characteristics, and biocompatibility, nanosensors can detect biomarkers, pathogens, and physiological changes at extremely low concentrations. This capability is particularly valuable for early disease detection, such as cancer, cardiovascular disorders, and infectious diseases, where timely intervention is critical. Additionally, nanotechnology-enabled sensors can be integrated into wearable devices or implantable systems, allowing continuous health monitoring and remote patient management. Despite these advancements, challenges remain, including ensuring biocompatibility, addressing potential toxicity, and scaling up production for widespread clinical use. The convergence of nanotechnology with artificial intelligence and big data analytics further amplifies its potential, paving the way for smarter, more adaptive healthcare solutions. As nanotechnology continues to evolve, it holds immense promise for transforming medicine, enabling earlier diagnoses, more effective treatments, and improved quality of life for patients worldwide.

Keywords: *Nanosensors, medicine, diagnostics, drug delivery, biomarkers, wearable devices, implantable sensors, personalized medicine, early disease detection.*

NANOTECHNOLOGY IN ENVIRONMENTAL APPLICATIONS FOR OIL SPILL CLEANUP

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Abstract

The oil transport through oil tankers and pipeline has further aggrovated the risk of the oil spill. The oil spills cause devasting impacts on coastal ecosystems. Spill response method for coastal regions. Nanotechnology based method for marine oil spill cleanup, focused in recovery rate, reusability and cost. Marine oil spill remediation techniques most effective for nanotechnology. The magnetic paper based on ultralong hydroxyapatite nanowires standing out with recovery rate of over 99%. The chitosan – silica hybrid nanosorbant multiwall carbon nanotube (CNTs) are also promising for high recovery rates of upto 95-98% . The ability to be reused multiple times. The photocatalytic biodegradation approach and the nano-dispersion method are not benefit for reusability but they can never the less help of negative ecological effect of marine oil spills. Therefore, Marine oil spill situation is crucial for careful evaluation and selection of the most appropriate method.

***Keywords**: reusability, cleanup, recovery, Marine oil spill, nanotechnology.*

APPLICATIONS OF SINGLE CRYSTAL MATERIALS

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Abstract

Single crystal materials exhibit unique properties that make them essential for a variety of advanced technological applications. These materials, characterized by a continuous, uninterrupted atomic structure, offer superior mechanical, electrical, optical, and thermal properties compared to their polycrystalline counterparts. In electronics, single crystals are critical for the fabrication of high-performance semiconductors, integrated circuits, and optoelectronic devices. Their ability to carry electrical current with minimal resistance makes them ideal for power transmission and high-speed devices. In optics, single crystal materials, such as sapphire and lithium niobate, are used in high-precision laser systems, optical lenses, and sensors. Their homogeneous structure enables superior light transmission and minimal scattering, crucial for applications in telecommunications and medical imaging. Additionally, single crystal materials are utilized in aerospace and defense sectors, where high-strength, lightweight materials are required. Superalloys and titanium alloys, which are often single-crystalline, offer enhanced performance in extreme environments, such as in jet engines and turbine blades. The growing field of quantum computing also relies on single crystal semiconductors and superconducting materials for quantum bit (qubit) development. With advances in material science, the potential applications of single crystal materials continue to expand, offering novel solutions in energy storage, nanotechnology, and biomedical fields.

Keywords: *Single crystal materials, semiconductors, optoelectronics, superalloys, quantum computing, nanotechnology.*

NANO BASED MEDICINE WITH SYNTHESIS OF ZINC OXIDE AND ANDROGRAPHIS PANICULATA

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Abstract

A nanoparticle is a tiny particle that has at least one dimension in the range of 1 to 100 nanometres (nm). Due to their size, nanoparticles often exhibit unique physical, chemical, and biological properties that differ from their bulk counterparts. Nanoparticles can be made from various materials, including metals (like gold or silver), metal oxides (like zinc oxide). Zinc oxide nanoparticles (ZnO NPs) can indeed be synthesized using plant materials, a process known as “green synthesis” or “biogenic synthesis.” ZnO NPs is effectively against bacteria, fungi and viruses. Andrographis paniculata is a medicinal plant widely used in traditional system. It is well-known for its anti-diabetic, anti-inflammatory, antioxidant, and antimicrobial properties. The anti-diabetic activity of Andrographis paniculata is primarily attributed to its bioactive compounds, especially andrographolide, a diterpenoid lactone known for its therapeutic benefits. Antidiabetic activity refers to the substance to lower a blood sugar level and help to manage diabetes. In this review paper we have focused on the nano-based drug discovery with the ZnO NPs combined with the Antidiabetic activity of Andrographis paniculata. Combining Zinc Oxide (ZnO) nanoparticles with Andrographis paniculata for anti-diabetic applications is a promising approach in nanomedicine ZnO NPs can act as carriers, releasing Andrographis paniculata phytochemicals in a controlled manner, ensuring a sustained anti-diabetic effect. Ensuring the safe concentration of ZnO NPs to avoid cytotoxicity.

Keywords: *Zinc oxide Nanoparticles, Andrographis paniculata, Antidiabetic activity, Nano-based drug.*

APPLICATIONS OF NANOTECHNOLOGY IN MEDICAL FIELD

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Abstract

Nanotechnology is making significant strides in the realm of medicine, particularly through its applications in nanomedicine. Various types of nanoparticles are being explored for their potential in revolutionizing diagnostic tools, imaging techniques, targeted therapies, pharmaceuticals, biomedical implants, and tissue engineering. One notable advancement is the improved safety in administering highly toxic treatments, such as chemotherapeutic drugs for cancer, made possible through nanotechnology. Additionally, wearable devices equipped with this technology can monitor vital signs, assess cancer cell activity, and detect infections in real-time, providing critical insights into a patient's condition. These innovations promise to enhance doctors' access to vital information regarding health status and disease progression, potentially leading to more informed clinical decisions. Furthermore, the integration of predictive analytics and artificial intelligence in biomedicine presents exciting opportunities for tailored therapies. This paper delves into the various applications of nanotechnology in healthcare, summarizing its classes, features, and characteristics. It draws on a comprehensive review of relevant literature from platforms like Scopus, Google Scholar, and ResearchGate to provide a well-rounded perspective on the subject. To fully leverage the benefits of nanotechnology, collaboration among scientists, governments, civil society organizations, and the public will be essential in assessing its importance and guiding its development across multiple sectors. The current study highlights numerous potential uses of nanotechnology in medicine, offering a concise and organized report that will serve as a valuable resource for researchers, engineers, and scientists in their future endeavors.

Keywords: *Nanotechnology, medicine, treatment, nanomedicine*

NANO TECHNOLOGY IN GREEN EVOLUTION

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Abstract

Nanotechnology represents one of the most important solutions that will help to Overcome these challenges. Nanotechnology is helping to better manage organic farming using Natural products constructing to be nano-fertilizers, nano-pesticides, biosensors, nano Diagnostics, nano-growth stimulators, and others. Global agricultural production suffers from many challenges and problems, including Environmental pollution, soil degradation, climate change, depletion of natural resources and Others. Hence, the green synthesis of nanomaterials or the so-called nano-methods is one of the Requirements and components of organic farming. The use of plant parts such as stems, roots, Leaves, flowers, fruits and various beneficial microbes such as bacteria, fungi and algae are Essential for nanoparticle synthesis or called green synthesis. Organic nanos are formed through biological Methods, not physical or chemical, as they do not follow the standards of organic farming. In addition, organic nano Elements help agricultural production to make optimal use of natural resources in a more Sustainable way and reduce agricultural toxic residues. Therefore, this review is highlighted the new ways and approached for using nanomaterials in organic agriculture for sustainable Agricultural productivity, food security and climate change.

Keywords: *Nano organic fertilizer, Nano pesticides, Nano plant growth stimulators, Green Synthesis*

NANO SCALE PROCESS IN ENVIRONMENT

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Abstract

Nanotechnology offers innovative solutions to pressing environmental challenges by leveraging materials at the nanoscale to enhance pollution remediation, resource management, and sustainability. This review explores the application of nanomaterials in environmental contexts, focusing on their roles in pollution reduction, water treatment, energy efficiency, and environmental monitoring. Nanoscale zero-valent iron (nZVI) particles have demonstrated efficacy in remediating soil and groundwater contaminants, including chlorinated solvents and heavy metals, due to their high reactivity and cost-effectiveness. Carbon-based nanoparticles and metal oxide nanoparticles are utilized in air purification, soil remediation, and water treatment processes, employing mechanisms such as adsorption, photocatalytic degradation, and membrane filtration to remove pollutants. Additionally, nanotechnology enhances renewable energy applications by improving the efficiency of solar cells and providing superior thermal insulation materials. Advanced nano sensors enable real-time environmental monitoring, facilitating the detection of pollutants at trace levels. While nanotechnology presents significant environmental benefits, considerations regarding the potential risks of nanoparticle release, production costs, and the need for comprehensive regulations are critical for sustainable implementation.

Keywords: *Nanotechnology, environmental remediation, zero-valent iron nanoparticles, pollution reduction, water treatment, energy efficiency.*

NANOMATERIALS AND THEIR MULTIFACETED APPLICATIONS: ADVANCEMENTS, CHALLENGES, AND FUTURE PROSPECTS

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Abstract

Nanomaterials have emerged as a transformative force across multiple scientific disciplines, offering groundbreaking advancements in medicine, environmental science, and material engineering. Their unique physicochemical properties enable precise control over biological and chemical interactions, making them highly effective in applications such as Nano drugs, bio sensing, bioremediation, and nanofabrication. In the medical field, nanotechnology has revolutionized drug delivery by allowing targeted therapy, controlled drug release, and reduced systemic toxicity, significantly improving treatment outcomes for conditions like cancer and neurodegenerative diseases. Additionally, Nano medicine plays a crucial role in diagnostics, personalized treatment, and regenerative medicine. In environmental science, nanomaterials facilitate pollutant degradation, water purification, and sustainable agricultural practices, supporting green revolution strategies and ecosystem restoration. Moreover, the integration of nanoscale processes in materials science has led to the development of advanced polymer Nano composites, luminescent materials, crystalline structures, and semiconductors, all of which have diverse applications in electronics, energy storage, and high-performance devices. Nanotechnology-based sensors have further enabled real-time monitoring and diagnostics in healthcare, industrial automation, and environmental surveillance, enhancing accuracy and efficiency.

Keywords: *Nanomaterials, Green revolution, Nano drugs, Bioremediation, Nano medicine, Nanotechnology,*

NANO MATERIAL- BASED APPLICATION FOR MEDICINE

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Abstract

Nanomaterial-based applications are revolutionizing the field of medicine, offering innovative solutions for diagnostics, drug delivery, and therapeutic interventions. Nanoparticles, due to their unique physicochemical properties such as high surface area-to-volume ratio, tunable size, and ability to interact at the cellular and molecular levels, provide unprecedented precision and efficiency in medical treatments. In drug delivery systems, nanocarriers like liposomes, dendrimers, and polymeric nanoparticles enhance the bioavailability, stability, and targeted delivery of therapeutic agents, minimizing side effects. Additionally, metal nanoparticles, such as gold and silver, are employed for bioimaging, cancer therapy, and antimicrobial treatments. Carbon-based nanomaterials like carbon nanotubes and graphene hold promise for tissue engineering and biosensors. Moreover, advancements in nanomedicine enable early disease detection through nanoparticle-based contrast agents and biosensors, significantly improving diagnostic accuracy. This abstract highlight the transformative potential of nanomaterials in medicine, underscoring their role in enhancing treatment efficacy, reducing toxicity, and paving the way for personalized medicine approaches. Future research will focus on ensuring biocompatibility, safety, and large-scale production to fully realize the clinical potential of nanotechnology.

Keywords: *Drug delivery, Biomedical application, Diagnostic and Imaging, Tissue*

NANO DRUGS: A NEW FRONTIER IN MEDICINAL RESEARCH AND DEVELOPMENT

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Abstract

The development of advanced biomaterials has revolutionized the field of tissue engineering and regenerative medicine. These biomaterials, designed to mimic the structure and function of native tissues, have enabled the creation of functional tissue substitutes and promoted tissue regeneration. Recent advances in biomaterials science have led to the development of novel materials with enhanced biocompatibility, bioactivity, and mechanical properties. These biomaterials have been applied in various tissue engineering applications, including bone, cartilage, skin, and cardiovascular tissue regeneration. Additionally, biomaterials have been used to develop innovative drug delivery systems and biosensors. This work provides a comprehensive overview of advanced biomaterials for tissue engineering and regenerative medicine, highlighting their design, synthesis, and applications.

Keywords: *Tissue engineering, regenerative medicine, biocompatibility, bioactivity, drug delivery, biosensors.*

Exploring the Nano material- based application for medicine

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Abstract

Nanomaterials have emerged as a promising frontier in the field of medicine, offering novel solutions to a wide range of medical challenges. The unique properties of nanomaterials, such as their small size, high surface area, and ability to interact at the molecular level, enable them to be utilized in diagnostics, drug delivery, imaging, and tissue engineering. In drug delivery, nanoparticles can provide targeted delivery of therapeutic agents, improving efficacy while minimizing side effects. Nanomaterials are also being explored for use in biosensors, allowing for early detection of diseases with high sensitivity and precision. Furthermore, their ability to penetrate biological barriers and interact with cellular systems opens up new possibilities in regenerative medicine and personalized treatments. This paper reviews the current applications of nanomaterials in medicine, highlighting their potential to revolutionize healthcare by enhancing the precision and effectiveness of medical treatments, as well as reducing risks and improving patient outcomes. Despite the promising developments, challenges related to safety, biocompatibility, and regulatory concerns remain key considerations in advancing nanomedicine.

Keywords: *Nanomaterials, Drug delivery, Nanoparticles, Bioavailability, Nanomedicine, Nanotechnology.*

NANO MATERIALS FOR GREEN REVOLUTION

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Abstract

Innovation in agriculture is nanotechnology which conceivably promises a green revolution beyond traditional farming. Incorporation of nanomaterials and devices in agricultural practices is a step towards precision farming and efficient resource utilization. One of the agricultural technology applications is in the nanoscale precision delivery system. Nutrients, pesticides, and herbicides are encapsulated into nanoparticles and delivered with precision. Such delivery enables optimal use without harming the environment, which minimizes the need for excessive chemicals. The approach enhances eco-friendly agriculture and also aids in sustainable farming. Technology has enhanced the preservation of soil health and fertility. In addition, the soil has built in nanosensors that send information about the moisture level, nutrients, and the general health of the soil. This kind of informed farming assists farmers in making the right decisions for crop management and helps in increasing productivity. Nanoparticle pesticide formulations are more effective in controlling pest activity at much lower concentrations. Smart nanomaterial-based packaging can be used to sustainably preserve agricultural produces for longer time periods and thus reduce post-harvest losses.

KEYWORDS: *Green revolution, Nanomaterials, Nanoscale precision delivery system, Encapsulation, Sustainable, farming, Nanosensor.*

NANO MATERIALS FOR BIOREMIDIATION

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Abstract

The contamination of ecosystems by organic and inorganic pollutants has increased significantly due to rising anthropogenic activities, posing a major challenge to global food safety and environmental health. Various physical and chemical remediation strategies have been explored for pollutant removal; however, these methods are often constrained by high costs, inefficiency, toxic by-products, and substantial capital requirements. Thus, achieving environmental sustainability necessitates the development of efficient, eco-friendly, and economically viable remediation approaches. In recent decades, the use of nanoparticles for contaminant reduction has gained prominence due to their small size, high reactivity, and catalytic efficiency. Nanoparticles have been effectively utilized to remediate contaminated soil and water. Additionally, microbial species, including bacteria, fungi, and algae, play a crucial role in bioremediation by degrading or immobilizing hazardous substances through enzymatic activity. The integration of nanotechnology with microbial inoculants—termed Nano bioremediation—has emerged as a highly efficient strategy for pollutant removal. This approach enhances microbial degradation processes, offering a cost-effective and environmentally sustainable solution with minimal toxic consequences. This review highlights the applications of nanoparticles in various sectors and their role in eliminating hazardous contaminants such as xenobiotic compounds, synthetic dyes, and heavy metals. By leveraging nanotechnology and microbial-assisted remediation, Nano bioremediation presents a promising avenue for large-scale environmental cleanup and sustainable development.

KEYWORDS: *Ecosystem, Anthropogenic activities, Remediation, Nano bioremediation, Sustainable development.*

ANTI-COCKROACH ACTIVITIES OF BIOSYNTHESIZED SILVER NANOPARTICLES USING *PETIVERIA ALLIACEA* EXTRACTS

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Abstract

Cockroach one of the major household insect pest which causes various diseases to human beings. *Petiveria alliacea*,has been widely used in folk medicine to treat inflammation, infection, and as an anticancer agent. This study investigates the anti-cockroach activities of biosynthesized silver nanoparticles (AgNPs) using *Petiveria alliacea* with its roots and leaf extracts. The aqueous extract of P. Alliacea was used as a reducing and stabilizing agent for the synthesis of AgNPs from silver nitrate (AgNO3). UV-Vis spectrophotometry. UV-Vis spectroscopy, Fourier Transform Infrared Spectroscopy (FTIR), X-Ray Diffraction (XRD), and Scanning Electron Microscopy (SEM) were used to characterize biosynthesized AgNPs to confirm their morphology and other nature. PAR-AgNPs and PaL-AgNPs were tested using two modes of application(fumigant and contact toxicity). The synthesized AgNPs were tested against *Periplaneta americana* (American cockroach) through contact and ingestion methods. The result indicates that peak absorbance of both AgNPs occurred at the wavelength of 426 and 442 nm with brownish colloidal solutions .FTIR peaks indicated the presence of alkene whereas TEM and EDX analysis shows the presence of silver with the spherical nanoparticles. Both AgNPs demonstrated insecticidal action against adult cockroaches. The toxic effect were dose-dependent with higher concentration causing rapid immobilization and mortality The phytochemicals present in *P.alliacea* couples with a timing properties of silver nanoparticles. Therefore, it is concluded that the pest management program for household pests, particularly cockroaches can incorporate silver nanoparticle-based insecticides on field of efficacy, environmental safety and mode of action.

Keywords: Silver nanoparticles, Cockroach, *P.alliacea,*

NANOTECHNOLOGY, A TOOL FOR DIAGNOSTICS AND TREATMENT OF CANCER

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Abstract

Nanotechnology refers to research and technology development at the atomic, molecular, and macromolecular scale, leading to the controlled manipulation and study of structures and devices with length scales in the 1-100 nanometres range. Nanotechnology has shown promising advancements in the field of drug development and its delivery. Nano devices can detect cancer cells, identify cancer signatures and provide targeted delivery of anti cancer therapeutics and contrast agents to tumour cells. This abstract elevates the early detection of cancer lies in the liability of existing tools to detect molecular level changes during early phases in the development of cancer. . Nanoparticles are classified into inorganic nanoparticles such as gold nanoparticles and organic nanoparticles such as carbon nanotubes and dendrimers. Different types of Nanoparticles such as polymeric nanoparticles (nanogels, nanofibers, liposomes), metallic nanoparticles such as gold NP (GNPs), sliver NP (AgNP), calcium nanoparticles (CaNPS), carbon nanotubes (CNTS), graphene, and quantum dots (QDs) have revolutionized cancer diagnostics and treatments due to their high surface charge, size, and morphology. Nanotechnology could provide a quick, safe, cost-effective, and efficient method for cancer management. Conventional cancer therapy methods are not efficient. It also provide simultaneous diagnosis and treatment of cancer using nano-theroagnostic particles that faciliate early detection and selective destruction of cancer cells. This review discusses the application of nanotechnology in cancer diagnosis, therapeutics, and theragnosis and provides future perspectives in the field.

Keywords: cancer therapeutics , nanotechnology, diagnosis, treatment, theragnostics.

NANOMATERIALS FOR GREEN REVOLUTION

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Abstract

The development of nanomaterials has emerged as a pivotal approach in advancing sustainable agricultural practices, contributing significantly to the Green Revolution. Nanotechnology in agriculture presents innovative solutions for enhancing crop productivity, soil health, and pest management while minimizing the environmental impact of conventional farming methods. Nanomaterials, such as nanoparticles, Nano composites, and Nano coatings, exhibit unique properties that make them ideal candidates for improving the efficiency of fertilizers, pesticides, and water usage. Their high surface area, reactivity, and ability to deliver nutrients and chemicals in a controlled manner enable targeted action with minimal waste. Furthermore, the application of nanomaterials in precision agriculture aids in the early detection of plant diseases, pest infestations, and soil quality degradation, promoting resource conservation and reducing the dependency on harmful chemicals. As a result, nanotechnology offers promising pathways for sustainable crop production, enhanced food security, and the reduction of agriculture's carbon footprint. Despite the promising potential, challenges related to toxicity, environmental impact, and regulatory frameworks must be addressed to ensure the safe and responsible application of nanomaterials. Ongoing research and development in this field hold the key to shaping the future of agriculture, driving the Green Revolution towards an eco-friendlier and resource-efficient

Keywords: *Nanomaterials, Green Revolution, sustainable agriculture, nanoparticles, precision farming*

NANOTECHNOLOGY AND SENSORS: A REVOLUTIONARY INTERSECTION

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Abstract

The integration of nanotechnology and sensors has given rise to a new paradigm in detection, monitoring, and analysis. Nanoscale materials and structures have enabled the development of ultra-sensitive, miniaturized sensors with unprecedented performance. These sensors have far-reaching implications in fields such as healthcare, environmental monitoring, and industrial process control. Recent advancements in nanotechnology have led to the creation of novel sensing platforms, including nanowire-based sensors, graphene-based sensors, and nanostructured surface-enhanced Raman spectroscopy (SERS) sensors. These sensors offer enhanced sensitivity, selectivity, and stability, enabling the detection of biomolecules, chemicals, and physical parameters with unprecedented precision. Nano science highlights the current state-of-the-art in nanotechnology and sensors, emphasizing their potential to transform various industries and improve our daily lives. Potential applications for nanosensors include medicine, detection of contaminants and pathogens, and monitoring manufacturing processes and transportation systems.

Key Points: *Sensors, Nanoscale Materials, Environmental Monitoring, Industrial Process Control.*

MATERIALS FOR BIOLOGICAL APPLICATION: ADVANCING HEALTHCARE THROUGH INNOVATIVE BIOMATERIALS.

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Abstract

The development of materials for biological applications has transformed the healthcare landscape, enabling the creation of innovative medical devices, implants, and diagnostic tools. Biomaterials, encompassing metals, ceramics, polymers, and composites, have been engineered to interact with living tissues, promoting tissue regeneration, repair, and replacement. Advances in materials science and nanotechnology have led to the development of novel biomaterials with enhanced biocompatibility, bioactivity, and mechanical properties. These biomaterials have been applied in various biological applications, including tissue engineering, drug delivery, and biosensing. Biomaterials-based scaffolds have been employed to regenerate damaged tissues, while nanostructured biomaterials have been utilized for targeted drug delivery and cancer therapy. This [paper/review] provides a comprehensive overview of materials for biological applications, highlighting their design, synthesis, and applications. We discuss current challenges and future directions, emphasizing the need for continued research and innovation to develop biomaterials that address the complex needs of healthcare.

Keywords: *Biomaterials, tissue engineering, biosensing, biocompatibility, bioactivity, healthcare.*

NANOMATERIALS BASED APPLICATION FOR MEDICINE

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Abstract

Nanomaterials are the leading edge of the rapidly developing field of nanotechnology. Nanotechnology is enabling technology that deals with nanometre sized objects. The principle of nanotechnology is applied to Nano medicine such as biomimicry and pseudo intelligence. Nanoparticles have become an essential part of medicine, from aiding in diagnostic tests to serving as immunotherapy agents and more. Due to their ultra small size — around the thickness of a strand of DNA — these particles are adopted at getting inside tissues and targeting precise areas. Nano medicine used for drug delivery ate made up of nanoscale. Particles which can improve drug bioavailability. Two forms of Nano medicine that have already been tested in mice and are awaiting human trials; use of gold Nano shells to help diagnose and cure cancer and the use of liposome as vaccine adjuvant and as vehicle for drug transport. Drug detoxification is also another application for Nano medicine which has been used successfully in rats. The advancement in nanotechnology helps in the treatment of neurodegenerative disorders such as Parkinson's disease and Alzheimer's disease. Nano medicine makes use of nanomaterials and nano electronic biosensors. With the help of Nano medicine early detection and prevention, improved diagnosis, proper treatment and follow up of disease is possible. Nano based drug delivery system for encapsulation and release of anti - TB drugs can lead to development of a more effective and affordable TB pharmacotherapy. Some application of nanotechnology to ophthalmology are include treatment of oxidative stress, measurement of intraocular pressure, treatment of choroidal new vessels, to prevent scars after glaucoma surgery etc.

Keywords: *Drug delivery, drug detoxification, biomimicry, pseudo intelligence.*

NANOMEDICINE – A TOOL FOR BIOLOGICAL SCIENCES.

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Abstract

Nano medicine, an emerging interdisciplinary field, harnesses the power of nanotechnology to revolutionize the diagnosis, treatment, and prevention of diseases. Nano medicine enables the development of novel therapeutic strategies that can target specific cells or tissues with high precision, enhancing the effectiveness of treatments while minimizing side effects. This phenomenon is particularly beneficial for complex diseases such as cancer, neurodegenerative disorders, and cardiovascular conditions, where traditional treatments often fall short. Nanoparticles, due to their small size and large surface area, can be engineered to carry drugs, genes, or imaging agents directly to the target site, improving drug delivery and allowing for real-time monitoring of therapeutic outcomes. Additionally, the field of Theranostics, which combines therapeutic and diagnostic functions in a single platform, offers significant promise for personalized medicine. Nano medicine is also advancing areas such as tissue regeneration, wound healing, and the development of innovative vaccines. Despite its potential, challenges such as the biocompatibility, toxicity, and regulatory approval of nanomaterials remain critical obstacles that need to be addressed. This abstract discusses the potential of Nano medicine as a powerful tool in biological sciences.

Keywords: *Targeted therapy, Theranostics, Drug targeting, Biocompatibility, Toxicity.*

LUMINESCENT MATERIALS: HARNESSING LIGHTS FOR INNOVATIVE APPLICATIONS

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Abstract

Luminescent materials have garnered significant attention in recent years due to their ability to emit light, enabling a wide range of applications in fields such as lighting, displays, biomedical imaging, and energy harvesting. These materials exhibit unique optical properties, including photoluminescence, electroluminescence, and thermoluminescence, which can be tailored through careful design and engineering. Recent advances in nanotechnology and materials science have led to the development of novel luminescent materials with enhanced efficiency, stability, and tunability. These materials include semiconductor quantum dots, rare-earth doped phosphors, and organic-inorganic hybrid perovskites. The unique properties of these materials have enabled innovative applications, such as ultra-high-definition displays, biomedical imaging probes, and luminescent solar concentrators. This [paper/review] provides a comprehensive overview of luminescent materials, highlighting their fundamental properties, synthesis methods, and applications. We also discuss the challenges and future directions in the field, emphasizing the need for continued research and innovation to unlock the full potential of luminescent materials.

Keywords: *luminescent materials, photoluminescence, electroluminescence, thermoluminescence, nanotechnology, materials science, quantum dots, phosphors, perovskites.*

NANO IN ACTION: THE FUTURE OF SMART SENSORS AND THEIR APPLICATION

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Abstract

Nanotechnology has revolutionized the development of smart sensors, enabling advancements that were once unimaginable. These sensors, constructed at the nanoscale, offer unparalleled sensitivity, precision, and miniaturization, transforming industries ranging from healthcare to environmental monitoring. The integration of nanomaterials, such as carbon nanotubes, quantum dots, and nanowires, enhances sensor performance by providing increased surface area and faster response times. These innovations lead to highly efficient and adaptable devices capable of detecting a wide range of physical, chemical, and biological parameters. The application of smart sensors is becoming increasingly important in areas such as health diagnostics, where nano sensors can detect early-stage diseases through the identification of specific biomarkers. In environmental monitoring, nanotechnology allows for real-time detection of pollutants, aiding in faster response to hazardous situations. Additionally, wearable technologies and smart devices benefit from nanosensors, offering continuous monitoring of vital signs and providing data for personalized health management. As these technologies evolve, the future of smart sensors lies in their ability to seamlessly integrate into daily life, becoming essential tools in creating a more connected and responsive world. The development of low-cost, high-performance nanomaterial-based sensors will further push the boundaries of what is possible, enabling innovations in automation, smart cities, and personalized medicine.

Keyword: *Smart sensors, healthcare, monitoring, wearable technology, biomarker.*

NANOFABRICATION: ENABLING NEXT GENERATION TECHNOLOGIES THROUGH PRECISION ENGINEERING AT THE NANOSCALE

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Abstract

Nanofabrication is a key technological advancement that enables the development of next-generation devices and systems by enabling the precise manipulation of materials at the nanoscale. Through various techniques, such as electron beam lithography, nanoimprint lithography, and molecular beam epitaxy, nanofabrication allows engineers to construct structures with resolutions as small as a few nanometers. This precision opens the door to innovations in fields ranging from electronics and photonics to biomedicine and energy. In electronics, for instance, nanofabrication plays a critical role in the miniaturization of transistors, enhancing the speed and efficiency of integrated circuits, and facilitating the development of more powerful computing devices. In photonics, the ability to control light at the nanoscale is transforming technologies such as quantum computing, sensors, and communication systems. Moreover, in the biomedical sector, nanofabrication enables the creation of highly sensitive diagnostic tools and advanced drug delivery systems, improving patient outcomes. As we push the boundaries of what is possible, precision engineering at the nanoscale is unlocking the potential for revolutionary breakthroughs. The continued advancement of nanofabrication techniques is crucial to addressing the demands of future technologies, driving innovations that will shape industries and improve lives globally. This paper explores the various nanofabrication techniques, their applications, and their impact on emerging technologies, highlighting their role in enabling the next generation of high-performance devices and systems.

***Keywords**: Nanofabrication, Lithography, Nanoimprint Lithography, Epitaxy, Quantum Computing.*

TITLE: NANO BASED DRUG DELIVERY SYSTEMS: RECENT DEVELOPMENTS AND FUTURE PROSPECT

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Abstract

Nanodrugs have revolutionized the field of medicine by providing targeted and efficient delivery of therapeutics. These tiny particles, measuring between 1-100 nanometers, can be engineered to target specific cells and tissues, reducing side effects and improving efficacy. Nanodrugs can be designed to deliver a wide range of therapeutics, including small molecules, proteins, and nucleic acids, making them a versatile tool for treating various diseases. Additionally, nanodrugs can be tailored to respond to specific stimuli, such as pH or temperature, allowing for controlled release of therapeutics. With their ability to improve drug delivery and reduce toxicity, nanodrugs hold great promise for treating a range of diseases, from cancer and infectious diseases to neurological disorders and cardiovascular disease. Nanomedicine sales reached $16 billion in 2015, with a minimum of $3.8 billion in nanotechnology R&D being invested every year. Global funding for emerging nanotechnology increased by 45% per year in recent years, with product sales exceeding $1 trillion in 2013. In 2023, the global market was valued at $189.55 billion and is predicted to exceed $ 500 billion in the next ten years. As the nanomedicine industry continues to grow, it is expected to have a significant impact on the economy.

Keywords: *Nanodrugs, nanomedicine, therapeutics, drug delivery, neurological disorder, cardiovascular disease.*

NANO MEDICINE A TOOL FOR BIOSCIENCES

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Abstract

Nanomedicine, the application of nanotechnology in healthcare, represents a transformative frontier in biosciences. By utilizing nanoparticles, nanodevices, and nanomaterials, nanomedicine has the potential to revolutionize diagnostics, drug delivery, and therapeutic interventions. With the ability to interact at the molecular and cellular levels, nanomedicine offers unprecedented precision, enabling targeted treatments with reduced side effects. In diagnostics, nanosensors and imaging agents allow for early detection of diseases at the molecular level, enhancing diagnostic accuracy and reducing the need for invasive procedures. In drug delivery, nanocarriers can be engineered to encapsulate therapeutic agents and deliver them directly to the affected cells or tissues, improving the efficacy of treatments while minimizing toxicity. Furthermore, nanomaterials have shown promise in regenerative medicine, where they facilitate tissue repair and cell regeneration. However, despite the significant advancements, challenges such as toxicity, biocompatibility, and regulatory concerns need to be addressed for the safe and effective use of nanomedicine in clinical practice. This review explores the various applications of nanomedicine in biosciences, focusing on current research, potential applications, and future directions for integrating nanotechnology into mainstream healthcare.

Keywords: *Nanomedicine, Nanotechnology, Drug delivery, Biosciences, Nanoparticles, Diagnostics*

EXPLORING THE POTENTIAL OF SEMICONDUCTING MATERIALS IN MODERN TECHNOLOGY

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Abstract

Nanomaterials have emerged as a revolutionary tool in medical applications, offering unique properties due to their small size, high surface area, and enhanced reactivity. These characteristics enable nanomaterials to play a pivotal role in drug delivery systems, diagnostics, tissue engineering, and imaging technologies. In drug delivery, nanoparticles such as liposomes, dendrimers, and polymeric nanocarriers can improve the bioavailability and targeting of therapeutics, minimizing side effects by selectively delivering drugs to specific cells or tissues. In diagnostics, nanomaterials are employed in biosensors and imaging agents, enabling early detection and more accurate monitoring of diseases, including cancer, through enhanced sensitivity. Additionally, nanomaterials contribute to tissue regeneration by promoting cell growth, differentiation, and wound healing, making them valuable in regenerative medicine. Furthermore, the development of nanomedicine also extends to the design of antimicrobial agents, where nanoparticles have shown remarkable efficacy against resistant pathogens. Despite their promising potential, challenges such as toxicity, biocompatibility, and regulatory concerns need to be addressed for the widespread clinical application of nanomaterials in medicine. Ongoing research aims to overcome these hurdles and unlock the full potential of nanotechnology in transforming modern healthcare.

Keywords: *Nanomaterials, Drug delivery, Diagnostics, Tissue engineering, Regenerative medicine, antimicrobial agents*

NANOMATERIALS IN BIO REMEDIATION

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Abstract

The functional aspect of Nanotechnology (NBT) is driven either to accelerate the performance of materials that are used for the purpose. Most significantly, its potential attribute to the environment includes the treatment and remediation, sensing and detection and pollution prevention. In general Nano- bio remediation (NBR) involves the use of Nano-materials either in in-situ (in place), or ex- situ (off place) treatment of contaminated materials. To accomplish the, the elemental or zero- valent metals and like materials nano form (1 – 100nm) have been applied as an instinctive need to embrace sustainable environment. The use of nanomaterials initially reduces the biodegradable contaminants and then it promotes to achieve the standard levels. Thus, the role of nanomaterials could be an efficient, effective approach to remediate the environmental contaminant sustainably. It also analysed the response of living organisms employed to remediate the contaminants in the presence nanomaterials. However further research is required to record the detailed fate of the nanomaterials that are used in environment remediation. Thus, use of Nanotechnology for bio remediation is the emerging field playing an increasingly important role in addressing innovative and effective solutions to a vast range of environmental challenges.

Keywords: *Nanomaterials, Bio remediation, environment, sensing, detection, biodegradable.*

"SINGLE CRYSTALS'

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Abstract

Single crystals are solids with a continuous and unbroken atomic arrangement, making them superior in mechanical, electrical, optical, and thermal properties compared to polycrystalline and amorphous materials. They are widely used in semiconductors, optics, and advanced materials research. Common growth methods include the Czochralski process, Bridgman technique, and vapor phase growth, enabling the production of high-purity crystals for electronic devices like silicon wafers and gallium arsenide-based optoelectronics. Their anisotropic properties make them valuable in piezoelectric materials, superconductors, and turbine blades, where directional properties enhance performance. The absence of grain boundaries reduces defects, improving conductivity, strength, and optical clarity. However, producing large, defect-free single crystals is expensive and time-consuming, limiting widespread use. Research focuses on refining growth techniques to improve quality and reduce costs. With advancements in nanotechnology and materials science, single crystals continue to drive innovations in electronics, photonics, and high-performance materials.

KEYWORDS: *Single crystals, grain boundaries, semiconductors, anisotropic properties, piezoelectric materials, superconductors, nanotechnology.*

EXPLORING THE NANOPARTICLES IN THE NANO VACCINES

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Abstract

Nano vaccines that utilizes nanoparticles to enhance immune system stimulation and facilitate efficient antigen delivery. It acts as delivery vehicles and immune stimulstors. Cancer vaccines combine exogenous tumor antigens with adjuvants or dendritic cells (DCs) to activate DCs, stimulating strong anti-tumor immunity. Therapeutic tumor vaccines harness the patient's immune system to activate antigen-specific cascade immune responses, achieving the killing effect on tumor cells, establishing durable immune memory, and reducing nonspecific or adverse effects. The use of tumor vaccines for treating established malignancies has a long history, dating back to the 1910s when William B. Coley injected sarcoma patients with killed streptococci and Serratia marcescens. However, the heterogeneity and low immunogenicity of tumors, as well as immune escape mechanisms, inhibit the effectiveness of tumor vaccines. The rapid development of biotechnology and materials science has led to the emergence of tumor nanovaccines, which utilize nanoparticles (NPs) as carriers to deliver tumor antigens and immunomodulators, activating the immune system to generate a targeted immune response against the specific tumor. Nanovaccines possess numerous advantages compared to conventional vaccines, such as encapsulation of antigens, stable delivery platform, multiple immune stimulations, precise control of NP size and shape, targeted delivery to lymphoid tissues and antigen-presenting cells, and immune adjuvant properties. Nano vaccine technology is still under development , but it holds great promise for the future of vaccine development.

Keywords: *Nano carriers, Adjuvants, William B. Coley, Streptococcus,Serratia marcescens, tumor vaccine, lymphoid tissues, stimulators.*

EXTRACTION AND CHARACTERIZATION OF NANOPARTICLES FROM SOIL AND WATER

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Abstract

Nanoparticles (NPs) naturally occur in various environmental matrices, including soil and water, due to geological, chemical and biological processes. This study explores the extraction, characterization and potential applications of nanoparticles derived from these natural sources. Soil and water samples were collected from different locations and subjected to a series of extraction techniques, including sedimentation, filtration and centrifugation to isolate nanoparticles. The extracted nanoparticles were characterized using techniques such as scanning electron microscopy (SEM), energy-dispersive X-ray spectroscopy (EDS), dynamic light scattering (DLS), and Fourier transform infrared spectroscopy (FTIR) to analyse their morphology, composition and functional properties. The results indicated that soil-derived nanoparticles predominantly contained iron oxides, silica and clay minerals, whereas water samples yielded colloidal silica, organic nanoparticles and biogenic nanomaterials produced by microbial activities. The study suggests that these naturally occurring nanoparticles hold potential applications in environmental remediation, sustainable agriculture, and nanotechnology-based water treatment. Further investigation into their functional properties and scalability of extraction methods could lead to eco-friendly and cost-effective nanomaterial applications.

Keywords: *Natural Nanoparticles, Soil, Water, Extraction, Characterization.*

APPLICATIONS OF LUMINESCENT MATERIALS IN BIOTECHNOLOGY

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Abstract

Luminescent materials have gained significant attention due to their ability to emit light upon excitation, making them valuable in various scientific and industrial applications. These materials, which include phosphors, quantum dots and rare-earth doped compounds, are widely used in display technologies, biomedical imaging, sensors and security features. Their unique optical properties, such as high brightness, long afterglow and tunable emission spectra, enable advancements in energy-efficient lighting, optical devices, and medical diagnostics. This paper explores the types, mechanisms, and applications of luminescent materials, highlighting their role in modern technology and potential future developments in photonics and nanotechnology.

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Keywords: *Luminescent materials, biomedical imaging, display technology, optical devices*

DRUGS DELIVERY BASED ON NANOMATERIALS IN LUNG CANCER THERAPY

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Abstract

Lung cancer is the most common malignant tumor world-wide, with approximately 2.5 million new lung cancer cases in 2022. It ranks first in morbidity and mortality among all diagnosed malignant tumors and thus lung cancer is still the leading cause of cancer-related deaths .lung cancer leads in causing cancer-related mortality worldwide continually posing a significant threat to human health. Nanodrug delivery systems can release drugs under specific conditions, thus realizing tumor-targeted drug delivery, which improves the antitumor effect of drugs. In this paper, we review the current treatments for lung cancer and further discuss the advantages and common carriers of nanodrug delivery systems. Although there have been tremendous advances in the treatment of lung cancer in the last decade, the mortality rate associated with lung cancer remains high. This articlesummarizes the current treatment strategies and shortcomings of lung cancer in order to find new treatments to improve the survival time of lung cancer patients. Nano-carrier based drug delivery systems can deliver drugs to tumor tissues in a targeted manner and effectively inhibit the growth of cancer cells. Recent findings suggest that nanotechnology-based approaches in combination with surgicaltreatment, chemotherapy, radiation therapy, immunotherapy, and molecularly targeted therapy show great potential in the treatment of lung cancer. We also summarize the latest research progress of nano-targeted drug delivery systems in the field of lung cancer therapy, Nanotechnology's advancement provides new solutions for the diagnosis and treatment of lung cancer promising to enhance diagnostic accuracy and reduce side effects during treatment.

Keywords: *Lung cancer, Nanodrug, drug delivery systems, Nanocarrier*

NANODRUGS: REVOLUTIONIZING THE MEDICINAL FIELD THROUGH TARGETED THERAPEUTICS

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Abstract

The advent of nanotechnology has transformed the medicinal field, enabling the development of Nano drugs with enhanced efficacy and reduced toxicity. Nano drugs, engineered to precise specifications, can target specific cells, tissues, or organs, ensuring optimal therapeutic outcomes. This targeted approach minimizes side effects, improves patient compliance, and reduces healthcare costs. Recent advances in nondrug design and synthesis have led to the creation of novel therapeutic agents for various diseases, including cancer, infectious diseases, and neurological disorders. Nano drugs have demonstrated improved solubility, stability, and bioavailability, enabling more effective treatment strategies. Furthermore, Nano drugs can be engineered to respond to specific stimuli, such as pH, temperature, or light, allowing for controlled release and activation. This [paper/review] provides an overview of the current state-of-the-art in nondrug development, highlighting their design, synthesis, and applications in the medicinal field. We discuss the challenges and future directions in Nano drug research, emphasizing the need for continued innovation and interdisciplinary collaboration.

Keywords: *Nano drugs, drug delivery, nanoparticles, targeted therapy, bioavailability, liposomes, polymeric nanoparticles, dendrites, blood-brain barrier, personalized medicine.*

NANO MATERIALS FOR BIOREMIDIATION

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Abstract

The contamination of ecosystems by organic and inorganic pollutants has increased significantly due to rising anthropogenic activities, posing a major challenge to global food safety and environmental health. Various physical and chemical remediation strategies have been explored for pollutant removal; however, these methods are often constrained by high costs, inefficiency, toxic by-products, and substantial capital requirements. Thus, achieving environmental sustainability necessitates the development of efficient, eco-friendly, and economically viable remediation approaches. In recent decades, the use of nanoparticles for contaminant reduction has gained prominence due to their small size, high reactivity, and catalytic efficiency. Nanoparticles have been effectively utilized to remediate contaminated soil and water. Additionally, microbial species, including bacteria, fungi, and algae, play a crucial role in bioremediation by degrading or immobilizing hazardous substances through enzymatic activity. The integration of nanotechnology with microbial inoculants—termed Nano bioremediation—has emerged as a highly efficient strategy for pollutant removal. This approach enhances microbial degradation processes, offering a cost-effective and environmentally sustainable solution with minimal toxic consequences. This review highlights the applications of nanoparticles in various sectors and their role in eliminating hazardous contaminants such as xenobiotic compounds, synthetic dyes, and heavy metals. By leveraging nanotechnology and microbial-assisted remediation, Nano bioremediation presents a promising avenue for large-scale environmental cleanup and sustainable development.

KEYWORDS: Contamination, Ecosystems, Anthropogenic activities, Food safety, Environmental health, Remediation strategies, Nanoparticles, Contaminant reduction.

MATERIALS FOR BIOLOGICAL APPLICATIONS

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Abstract

Materials for biological applications refer to engineered substances designed to interact with biological systems in a controlled, beneficial manner. These materials have a broad range of uses, from medical devices and diagnostics to tissue engineering and drug delivery. The key properties that make materials suitable for biological applications include biocompatibility, biodegradability, and the ability to mimic or support natural biological processes.**Biocompatible materials** are designed to interact with living tissues without eliciting an immune response or causing toxicity. Examples include metals like titanium, polymers such as polyethylene, and ceramics used in medical implants and prosthetics. **Biodegradable materials**, on the other hand, break down naturally over time, reducing the need for surgical removal and making them ideal for drug delivery systems and tissue scaffolds. Common biodegradable materials include polylactic acid (PLA) and polycaprolactone (PCL).**Smart materials** respond to external stimuli, such as temperature, pH, or electrical fields. These materials are highly useful in drug delivery systems, where they can release therapeutic agents at specific sites in response to environmental changes. **Hydrogels**, which are capable of absorbing large amounts of water, are another important category used in wound care, drug delivery, and tissue engineering. **Nanomaterials** exhibit unique properties at the nanoscale and can be employed in applications like cancer therapy, biosensing, and imaging.

KEYWORDS: *Biomaterials, biocompatibility, biodegradability, tissue engineering, drug delivery, regenerative medicine, nanomaterials, bioinspired materials, 3D bioprinting, medical implants.*

NANO SCALE PROCESS IN ENVIRONMENT

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Abstract

Nanoscale processes play a crucial role in environmental systems, influencing physical, chemical, and biological interactions. These processes occur naturally, such as in the formation of nanoparticles through weathering, volcanic activity, and biological mechanisms, or can be influenced by engineered nanomaterials. At the nanoscale, unique properties such as high surface area, reactivity, and colloidal behavior impact pollutant transport, biogeochemical cycling, and ecosystem health. Natural and anthropogenic nanoparticles contribute to critical processes like carbon sequestration, nutrient cycling, and heavy metal transformation. Understanding nanoscale environmental interactions is essential for assessing ecological risks, developing sustainable nanotechnologies, and mitigating environmental contamination. This review highlights key nanoscale mechanisms and their implications for environmental science and sustainability. Natural Nanoscale Processes;Atmospheric Nanoparticles: Tiny particles in the air, such as aerosols, influence climate by reflecting or absorbing sunlight and aiding cloud formation.Soil and Water Interactions: Natural nanoparticles like clay, minerals, and organic matter help in nutrient cycling and pollutant degradation.Microbial Nanostructures: Bacteria and other microorganisms use nanoscale structures for survival, biofilm formation, and breaking down pollutants.

Key points : *Air pollution control, water purification, soil Red meditation, Renewable Energy and sustainability, waste management and Recycling***.**

NANO MATERIALS FOR GREEN REVOLUTION

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Abstract

The Green Revolution, which revolutionized agriculture in the mid-20th century, focused on increasing food production through the use of high-yield crops, synthetic fertilizers, and irrigation. However, with rising global population pressures and environmental challenges, the need for sustainable agricultural practices has become imperative. Nanomaterials, due to their unique properties at the nanoscale, offer promising solutions to enhance agricultural productivity while minimizing environmental impact. These materials, such as nanoparticles, nanocomposites, and nanostructured coatings, can be utilized in a variety of agricultural applications, including nutrient delivery, pest control, soil remediation, and water management. Nanomaterials can enable more efficient and targeted delivery of fertilizers and pesticides, reducing chemical runoff and improving crop yields. For example, nanofertilizers are designed to release nutrients in a controlled manner, ensuring plants receive optimal nourishment over time. Additionally, nanomaterials can be used in sensors for real-time monitoring of soil health, moisture levels, and pest infestations, allowing for precision agriculture. Nanotechnology also aids in enhancing water use efficiency by improving irrigation systems or developing hydrophobic materials that reduce water evaporation. Furthermore, the integration of nanomaterials in biodegradable agricultural films and packaging reduces plastic waste and contributes to a circular agricultural economy. Despite these advancements, concerns over the potential toxicity and long-term environmental impact of nanomaterials need to be thoroughly addressed through rigorous research and regulation.

KEYWORDS: *sustainable agriculture, nanotechnology in agriculture, nanofertilizers, eco friendly farming, water management, pest control.*

POLYMER NANOCOMPOSITIES

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Abstract

Polymer nanocomposites are a new class of composite materials containing inorganic nanoparticles dispersed in organic polymer matrix to improve its performance properties. Polymer nanocomposites have two components: polymer and the nano-fillers. The introduction of nano-fillers into the polymer matrix combines the advantages of both the materials. Polymer nanocomposite may be classified based on the morphology of the obtained polymer nanocomposites, dimension of nanomaterials, thermal response, and class of polymers. Polymer nanocomposites can be prepared by many methods, but the most common methods are solution dispersion, in situ polymerization, and melt extrusion. Polymer nanocomposites display excellent properties such as magnetic efficiency, electrical properties, and barrier resistance. The important advantages of polymer nanocomposites are due to increased stiffness, increased resistance to fire, increased thermal and dimensional stability, good optical properties, and improved barrier effect. Owing to extraordinary properties and potential applications, polymer nanocomposites are utilized in different emerging areas such as in medical, electrical, catalytic, sensors, and environmental fields

KEYWORDS: *nanoparticles, natural nanofibers, biopolymers, composites, polymer nanocomposites; nanomaterials; internal interfacial area; nano-structure; multifunctional properties.*

MATERIALS FOR BIOLOGICAL APPLICATIONS

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Abstract

Biomaterials are materials that are used to interact with biological systems, such as the human body. Biomaterials are materials it be like natural, synthetic, glass & metal alloy materials that interact with biological system. Bio materials science, biology, chemistry, tissue engineering material science historically solution of material was based on availability and the in-Genuity of the individual making and applying the prosthetic we highlight the challenges and future directions in the development of materials for biological applications including the need for improved biocompatibility, biodegradability and functionality. It has also benefits in it improved biocompatibility, targeted drug delivery, increase implant lifespan, improved quality of life, advancements in medical research. Materials play a vital role in biological applications offering innovative solutions for medical devices, tissue engineering and drug delivery we can expect to see new and exciting applications of materials in biology leading to further improvements in human health and wellbeing.

KEYWORDS: *Biological material, Tissue engineering, Drug delivery, Biocompatibility, Biodegradability, Functionality.*

SINGLE CRYSTALS

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Abstract

Single crystals are solids with a continuous and unbroken atomic arrangement, making them superior in mechanical, electrical, optical, and thermal properties compared to polycrystalline and amorphous materials. They are widely used in semiconductors, optics, and advanced materials research. Common growth methods include the Czochralski process, Bridgman technique, and vapor phase growth, enabling the production of high-purity crystals for electronic devices like silicon wafers and gallium arsenide-based optoelectronics. Their anisotropic properties make them valuable in piezoelectric materials, superconductors, and turbine blades, where directional properties enhance performance. The absence of grain boundaries reduces defects, improving conductivity, strength, and optical clarity. However, producing large, defect-free single crystals is expensive and time-consuming, limiting widespread use. Research focuses on refining growth techniques to improve quality and reduce costs. With advancements in nanotechnology and materials science, single crystals continue to drive innovations in electronics, photonics, and high-performance materials.

KEYWORDS: *Single crystals, grain boundaries, semiconductors, anisotropic properties, piezoelectric materials, superconductors, nanotechnology.*

NANO DRUGS FOR MEDICINAL FIELDS

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Abstract

Nanotechnology has revolutionized drug delivery systems, offering innovative solutions for precision medicine. Nano drugs, which utilize nanoparticles as carriers, enhance the bioavailability, efficacy, and targeted delivery of therapeutic agents. These Nanocarriers, including liposomes, dendrimers, polymeric nanoparticles, and metallic nanoparticles, enable controlled drug release, reducing side effects and improving patient outcomes. In oncology, Nano drugs improve tumor targeting through enhanced permeability and retention (EPR) effects, minimizing damage to healthy tissues. In infectious disease treatment, antimicrobial nanoparticles combat drug-resistant pathogens. Additionally, Nano drugs contribute to regenerative medicine by facilitating tissue repair and gene therapy applications. Despite their potential, challenges such as toxicity, stability, regulatory approval, and large-scale manufacturing must be addressed. Ongoing research in Nanomedicine is focused on overcoming these barriers to optimize clinical applications. The integration of Nano drugs into mainstream medicine holds promising prospects for advancing personalized.

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Keywords: *Nano drugs, drug delivery, nanotechnology, oncology, regenerative medicine, targeted therapy*

CRYSTALLOGRAPHIC, VALENCE-BOND PARAMETERS AND THEORETICAL INVESTIGATIONS ON TRIS(DITHIOCARBAMATO)COBALT(III) COMPLEXES

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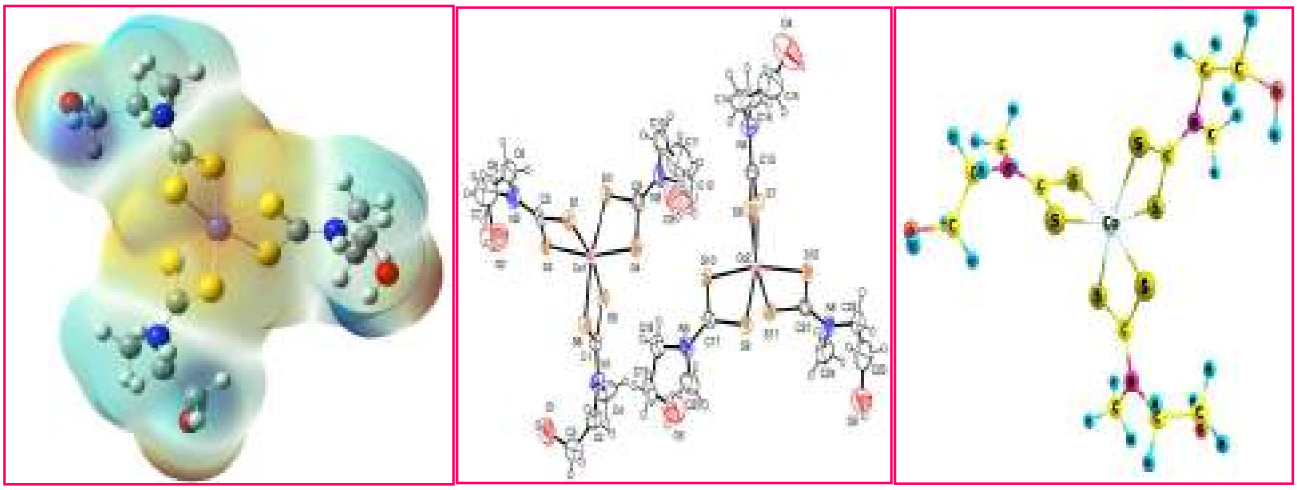
Abstract

Tris(disubstituted dithiocarbamate)cobalt(III) complexes, ethylaminodithiocarbamate (eedtc) (**1**)

and methylaminoethanoldithiocarbamate (medtc) (**2**) have been synthesized and characterized by using electronic, IR, NMR, CV and thermal analysis. Single crystal X-ray analysis of both the complexes showed distorted octahedral geometry. The short C-N thioureide bond distance in dithiocarbamate moieties indicates its partial double bond character which is due to the delocalization of π-electron density over S_2CN. Two asymmetric units are present in $[Co(medtc)_3]$. Bond valence sum (BVS) has been calculated for the complexes and oxidation state of the central cobalt atom is confirmed from crystallographic distances. Thermal analysis supported the proposed formulae for the complexes. The theoretical studies were performed utilizing the DFT with 6-31G (*d p*) level theory. The possible electronic transitions are determined by HOMO-LUMO energies. The structure activity relationship has been interpreted by MEP. Mulliken population analysis on atomic charges and other related molecular properties are also calculated. The hyper polarizability interaction energy and electron densities of donor and acceptor bonds are calculated by NBO analysis.



Keywords: *Dithiocarbamate, Cobalt (III), thioureide, Crystallogrphy, DFT, computational studies*

SINGLE CRYSTAL

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Abstract

Single crystal growth has been a widely studied method for synthesizing solid-state materials, with significant advancements in techniques over the past few decades. However, there has been limited focus on how to effectively disseminate this knowledge. This work aims to fill that gap by discussing both well-established and lesser-known single crystal growth techniques, particularly those that help optimize defect control in known materials. We provide a broader perspective on these synthesis methods, considering the interdependence of temperature and reaction time. We also address strategies for scaling up synthesis processes and overcoming existing challenges. This article seeks to contribute to the technological advancements and further developments necessary for achieving better control over material synthesis. The importance of material synthesis for modern life is emphasized, highlighting the relevance of crystal structures in determining the physical properties of materials. Additionally, the study of structural motifs offers valuable insights into current materials and provides opportunities to design new materials with enhanced properties.

keywords: *Single crystal growth, material synthesis, solid-state materials, defect control, reaction time, temperature dependence.*

THE STUDY OF ENVIRONMENTAL CHEMISTRY

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Abstract

Environmental chemistry studies the occurrence, movements, and transformations of chemicals in the living environments. It is an interdisciplinary field that studies the presence and impact of chemicals in soil, water, and living environment. It deals with the impact of chemicals and their effects on human health and organisms in the environment. It helps us trace and control contaminants. This paper provides the fundamentals of environmental chemistry and the effects of mankind's activities on the earth's chemical systems. A major impetus for environmental chemistry dates from the discovery in the 1970s of human health hazards caused by environmental pollution. Environmental chemists also began studying the effects of human-caused chlorofluorocarbons (CFCs) on the stratospheric ozone layer. Since then, environmental chemistry expanded to include the study of chemical compounds in water, soil, biological systems. Environmental chemistry should not be confused with green chemistry, which seeks to reduce potential pollution at its source, while environmental chemistry is the scientific study of the chemical phenomena that occur in natural places. It reduces toxicity, minimizes waste, and saves energy. Green chemistry is not confined to industrial sector. A contaminant or pollutant is a substance present in nature at a level higher than fixed levels or that would not otherwise be there. There are four million known chemicals in the world today and another 30,000 new compounds are added to the list every year. When a chemical is released into the environment, it is distributed among the four major environmental compartments: (1) air, (2) water, (3) soil, and (4) living organisms. The environmental interest in acid-base chemistry is focused on the capacity of natural waters and soils to resist pH changes resulting from human activity.

Keywords: *Environmental chemistry, pollutant level, CFCs.*

APPLICATIONS OF LUMINESCENT MATERIALS

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Abstract

Luminescent materials are a class of substances that emit light through various mechanisms, such as photoluminescence, electroluminescence, chemiluminescence, or bioluminescence. These materials have garnered significant attention due to their wide range of applications in fields such as optoelectronics, bioimaging, lighting, displays, and sensors. Luminescence occurs when a material absorbs energy and re-emits it in the form of visible or near-visible light. The efficiency, color, and duration of the emitted light depend on the material's composition, structure, and excitation source. Photoluminescent materials, including phosphors and quantum dots, are excited by ultraviolet or visible light and are widely used in LEDs, solar cells, and anti-counterfeiting technologies. Electroluminescent materials, such as organic light-emitting diodes (OLEDs), emit light when an electric current is applied, making them essential for modern display technologies. Chemiluminescent materials produce light through chemical reactions, with applications in forensic science and medical diagnostics. Bioluminescent materials, found in organisms like fireflies and jellyfish, have inspired advancements in biological research. Recent advancements in nanotechnology and material science have led to the development of highly efficient and tunable luminescent materials. For instance, perovskite-based materials and rare-earth-doped phosphors have shown exceptional luminescent properties, enabling their use in next-generation lighting and display technologies.

Keywords: *Luminescent materials, photoluminescence, electroluminescence, chemiluminescence, bioluminescence, phosphors, quantum dots.*

TECHNOLOGICAL APPLICATIONS OF NANOMATERIALS IN PHYSICS

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Abstract

Nano materials, with their unique properties stemming from their small size and large surface area to volume ratio, have found numerous applications in physics, particularly in the realm of technology. These applications include nanostructured materials for electronic devices, such as nanowires and quantum dots, which exhibit enhanced electrical conductivity and optical properties. In photonics, nano materials are utilized for developing high-resolution imaging techniques and advanced sensors capable of detecting minute changes in the environment. Further, nanostructured materials play a crucial role in the development of next-generation energy storage devices like supercapacitors and batteries with improved efficiency and longevity. The integration of nano materials in physics has paved the way for innovations in various fields, including materials science, electronics, photonics, and energy storage, making them essential components in modern technological advancements.

Keywords: *Nano materials, physics, technology, electronic devices, photonics, energy storage.*

APPLICATIONS OF NANOMATERIALS FOR CANCER DIAGNOSIS

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Abstract

Nanomaterials have emerged as transformative tools in cancer diagnosis and therapy, offering unprecedented precision, efficiency, and versatility. Their unique physicochemical properties, such as high surface area, tunable surface chemistry, and the ability to encapsulate or conjugate therapeutic agents, make them ideal for targeting cancer cells while minimizing damage to healthy tissues. In cancer diagnosis, nanomaterials enable early detection through advanced imaging techniques, such as magnetic resonance imaging (MRI), computed tomography (CT), and fluorescence imaging. Nanoparticles like quantum dots, gold nanoparticles, and superparamagnetic iron oxide nanoparticles enhance contrast and sensitivity, allowing for the identification of tumors at earlier stages. Additionally, nanosensors and nanodevices can detect cancer biomarkers with high specificity, facilitating non-invasive liquid biopsies.In cancer therapy, nanomaterials serve as carriers for targeted drug delivery, improving the bioavailability and reducing the systemic toxicity of chemotherapeutic agents. Functionalized nanoparticles can selectively accumulate in tumor tissues through passive targeting (enhanced permeability and retention effect) or active targeting (ligand-receptor interactions). They also enable combination therapies by co-delivering drugs, genes, and photosensitizers for synergistic effects. Furthermore, nanomaterials are integral to emerging therapies like photothermal therapy (PTT), photodynamic therapy (PDT), and immunotherapy, where they enhance therapeutic outcomes by leveraging external stimuli such as light or magnetic fields.

Keywords: *Nanomaterials, cancer diagnosis, targeted therapy, drug delivery, imaging, photothermal therapy, photodynamic therapy.*

APPLICATIONS OF NANOFABRICATION MATERIALS

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Abstract

Nanofabrication is a cutting-edge field focused on the design, creation, and manipulation of structures and devices at the nanoscale, typically ranging from 1 to 100 nanometers. This discipline is pivotal in advancing technologies across diverse sectors, including electronics, medicine, energy, and materials science. Nanofabrication techniques enable the production of nanostructures with precise control over their size, shape, and composition, unlocking unique physical, chemical, and biological properties that are not achievable at larger scales. The field encompasses both top-down and bottom-up approaches. Top-down methods, such as photolithography, electron-beam lithography, and nanoimprinting, involve the reduction of bulk materials to nanoscale dimensions. These techniques are widely used in the semiconductor industry to fabricate integrated circuits and microelectromechanical systems (MEMS). Bottom-up approaches, including self-assembly, chemical vapor deposition (CVD), and atomic layer deposition (ALD), build nanostructures atom-by-atom or molecule-by-molecule, offering high precision and the ability to create complex architectures. Recent advancements in nanofabrication have led to the development of novel materials like graphene, carbon nanotubes, and quantum dots, which exhibit exceptional electrical, thermal, and optical properties.

Keywords:

Nanofabrication, nanotechnology, top-down approach, bottom-up approach, photolithography, self-assembly, nanomaterials, sustainable fabrication, quantum dots.

NANOMEDICINE IN THE FIELD OF BIOLOGICAL SCIENCE

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Abstract

Nano medicine, an interdisciplinary field at the intersection of nanotechnology and medicine, has emerged as a transformative tool in biological sciences. By leveraging nanoscale materials and devices, nano medicine enables precise manipulation, diagnosis, and treatment at the molecular and cellular levels. This technology offers unprecedented opportunities for understanding biological processes, developing targeted therapies, and advancing personalized medicine. Nanoparticles, such as liposomes, dendrimers, and metallic nanoparticles, are engineered to deliver drugs with high specificity, minimizing off-target effects and enhancing therapeutic efficacy. Additionally, nano medicine facilitates early disease detection through advanced imaging techniques and biosensors, enabling timely intervention. In regenerative medicine, nanomaterials are used to create scaffolds that mimic the extracellular matrix, promoting tissue repair and regeneration. Furthermore, nano medicine plays a pivotal role in overcoming biological barriers, such as the blood-brain barrier, opening new avenues for treating neurological disorders. Despite its immense potential, challenges such as biocompatibility, toxicity, and regulatory hurdles remain. As a tool for biological science, nano medicine not only enhances our understanding of complex biological systems but also paves the way for innovative solutions to some of the most pressing medical challenges. Its integration with artificial intelligence and big data analytics further amplifies its impact, heralding a new era in healthcare and biomedical research.

Keywords:

Nano medicine, nanotechnology, drug delivery, targeted therapy, regenerative medicine, biosensors, personalized medicine.

NANOMATERIALS USED FOR BIOREMEDIATION

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Abstract

Nanomaterials have emerged as a promising tool for bioremediation, offering innovative solutions to address environmental pollution and contamination. Their unique properties, such as high surface area, reactivity, and tunable surface chemistry, make them highly effective in degrading, adsorbing, or transforming pollutants in soil, water, and air. Nanomaterials, including nanoparticles, nanotubes, and nanocomposites, are increasingly being utilized for the removal of heavy metals, organic pollutants, and toxic chemicals. For instance, zero-valent iron nanoparticles (nZVI) are effective in reducing chlorinated compounds, while carbon-based nanomaterials like graphene oxide and carbon nanotubes excel in adsorbing heavy metals and organic contaminants. Additionally, metal oxide nanoparticles, such as titanium dioxide (TiO_2) and zinc oxide (ZnO), exhibit photocatalytic properties that degrade organic pollutants under light exposure. The integration of nanomaterials with biological systems, such as microorganisms or enzymes, further enhances their bioremediation potential by combining the catalytic efficiency of nanomaterials with the specificity of biological processes. However, challenges such as potential ecotoxicity, long-term environmental impact, and scalability need to be addressed to ensure the safe and sustainable application of nanomaterials in bioremediation. Future research should focus on developing eco-friendly synthesis methods, improving the stability and selectivity of nanomaterials, and understanding their interactions with environmental matrices. Overall, nanomaterials hold significant promise for advancing bioremediation technologies, offering efficient, cost-effective, and sustainable solutions for environmental cleanup.

Keywords: *Nanomaterials, bioremediation, nanoparticles, environmental pollution, heavy metals, organic pollutants.*

TECHNOLOGICAL APPLICATIONS OF NANOSCALE PROCESS

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Abstract

Nano-scale processes in the environment involve the behavior, transformation, and interactions of nanoparticles (NPs) and nanomaterials within natural ecosystems. These processes are critical in understanding the environmental impact of nanotechnology, which has seen rapid growth in applications ranging from medicine to industrial manufacturing. At the nanoscale (1–100 nm), materials exhibit unique physical, chemical, and biological properties that differ significantly from their bulk counterparts. These properties influence their mobility, reactivity, and toxicity in environmental systems. Key processes include aggregation, dissolution, adsorption, and transformation of nanoparticles, which are governed by factors such as pH, ionic strength, organic matter, and microbial activity. For instance, nanoparticles can adsorb onto soil particles or dissolve into ions, affecting their bioavailability and potential ecotoxicity. Environmental nano-processes also play a role in the fate and transport of pollutants, as nanoparticles can act as carriers for heavy metals and organic contaminants, facilitating their spread in water, soil, and air. Additionally, natural nanoparticles, such as those formed from volcanic activity or mineral weathering, contribute to biogeochemical cycles. However, the increasing release of engineered nanoparticles into the environment raises concerns about their long-term ecological and human health impacts. Future research should focus on the interplay between natural and engineered nanoparticles, their lifecycle in the environment, and strategies to mitigate potential risks.

Keywords: *Nano-scale process, Environmental systems, Nanoparticles, Environmental remediation, Sustainability, Human health.*

GROWTH AND FORMATION OF SINGLE CRYSTALS

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Abstract

Single crystals are solid materials with a highly ordered, continuous atomic lattice structure extending throughout their entire volume, making them distinct from polycrystalline materials. Their unique structural perfection results in exceptional physical, chemical, and electronic properties, making them invaluable in various scientific and technological applications. Single crystals are characterized by their anisotropy, meaning their properties, such as mechanical strength, thermal conductivity, and electrical resistivity, vary with crystallographic orientation. This anisotropy is exploited in fields like optics, where single crystals are used in lasers, nonlinear optical devices, and waveguides due to their superior light transmission and minimal scattering. In electronics, single crystals of silicon and gallium arsenide form the backbone of semiconductor devices, enabling advancements in microelectronics and photovoltaics. The growth of single crystals is a critical process, achieved through techniques such as the Czochralski method, Bridgman-Stockbarger technique, and flux growth. These methods require precise control over temperature, pressure, and chemical composition to ensure defect-free crystals. Defects, such as dislocations or impurities, can significantly degrade performance, making defect minimization a key focus in crystal growth research.

Keywords: *Single crystals, anisotropy, crystal growth, Czochralski method, crystallography, semiconductor, defect minimization, quantum computing.*

NANOSTRUCTURED MATERIALS FOR ENERGY STORAGE

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Abstract

Nanostructured materials have emerged as a transformative solution for energy storage and conservation, offering enhanced performance due to their unique physical, chemical, and mechanical properties. These materials, characterized by their nanoscale dimensions, exhibit high surface area-to-volume ratios, improved electrical conductivity, and tunable porosity, making them ideal for applications in batteries, supercapacitors, and energy-efficient systems. In energy storage, nanostructured materials such as graphene, carbon nanotubes, and metal-organic frameworks (MOFs) have significantly improved the capacity, charge-discharge rates, and cycle life of lithium-ion batteries and supercapacitors. For instance, nanostructured electrodes facilitate faster ion diffusion and electron transport, addressing limitations in traditional energy storage devices. Additionally, nanomaterials like perovskite quantum dots and nanostructured silicon are being explored for next-generation solar cells, enhancing light absorption and energy conversion efficiency. In energy conservation, nanostructured coatings and films are used for thermal insulation and smart windows, reducing energy consumption in buildings by regulating heat transfer and light transmission. Furthermore, nanocatalysts play a pivotal role in energy-efficient chemical processes, such as hydrogen production and carbon capture, contributing to sustainable energy solutions.

Keywords: *Nanostructured materials, energy storage, energy conservation, batteries, supercapacitors, nanocatalysts, thermal insulation, solar cells, sustainability.*

NANOMATERIALS ON GREEN REVOLUTION

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Abstract

Nanomaterials have emerged as a transformative force in green revaluation, offering innovative solutions to address environmental challenges and promote sustainable development. Their unique properties, such as high surface area, tunable morphology, and exceptional catalytic activity, enable their application in diverse fields, including renewable energy, pollution remediation, and waste valorization. In renewable energy, nanomaterials enhance the efficiency of solar cells, fuel cells, and energy storage systems, reducing reliance on fossil fuels. For pollution control, they facilitate the degradation of pollutants, adsorption of heavy metals, and sensing of environmental contaminants, ensuring cleaner air and water. Additionally, nanomaterials play a pivotal role in converting waste into valuable resources, such as converting CO2 into fuels or transforming industrial byproducts into high-value materials. Their integration into green technologies aligns with the principles of circular economy and sustainable resource management. However, the environmental impact of nanomaterial synthesis and disposal must be carefully evaluated to ensure their lifecycle is truly sustainable. Advances in green synthesis methods, such as using plant extracts or bio-templates, are reducing the ecological footprint of nanomaterial production. Furthermore, the development of biodegradable and eco-friendly nanomaterials is gaining traction, addressing concerns about their long-term environmental effects. This review highlights the potential of nanomaterials in driving green revaluation, emphasizing their role in achieving global sustainability goals.

Keywords: *Nanomaterials, Green revolution, Environmental sustainability, Water purification, Soil remediation, Renewable energy.*

BIOLOGICAL APPLICATIONS OF SEMICONDUCTING MATERIALS

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Abstract

Semiconducting materials have emerged as a transformative platform for biological applications, bridging the fields of electronics and life sciences. These materials, including silicon, organic semiconductors, and emerging two-dimensional (2D) materials like graphene and transition metal dichalcogenides, exhibit unique electronic, optical, and mechanical properties that make them ideal for interfacing with biological systems. In bioelectronics, semiconducting materials are used to develop biosensors, wearable devices, and implantable systems for real-time monitoring of physiological signals, such as glucose levels, neural activity, and cardiac function. Their tunable bandgaps and high sensitivity enable precise detection of biomolecules, pathogens, and environmental changes. Additionally, semiconducting nanoparticles and quantum dots are widely employed in bioimaging and drug delivery, offering high-resolution imaging capabilities and targeted therapeutic delivery with minimal off-target effects. Moreover, advancements in flexible and stretchable semiconductors have paved the way for next-generation wearable technologies that seamlessly integrate with human tissues, enabling continuous health monitoring and personalized medicine. Despite these promising applications, challenges remain in optimizing the stability, toxicity, and long-term performance of these materials in biological environments.

Keywords: *Semiconducting materials, bioelectronics, biosensors, bioimaging, drug delivery, wearable devices, biocompatibility, quantum dots, neural interfaces, flexible electronics.*

SINGLE CRYSTALS

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Abstract

Single crystals are materials with a continuous and uninterrupted periodic atomic arrangement, free from grain boundaries. This structural perfection results in superior mechanical, electrical, and optical properties compared to polycrystalline or amorphous materials. Single crystals play a crucial role in advanced technologies, including semiconductors, high-performance optics, and turbine blades, where their uniformity enhances performance and reliability. Various growth techniques, such as the Czochralski method, Bridgman technique, and molecular beam epitaxy, are employed to produce high-purity single crystals. Ongoing research focuses on optimizing growth conditions, minimizing defects, and developing scalable production methods to meet the demands of modern applications.

Keywords: *Single crystal, crystal growth, Czochralski method, Bridgman technique, molecular beam epitaxy, semiconductor materials.*

CRYSTALLINE MATERIALS

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Abstract

Crystalline materials are solid substances in which atoms, ions, or molecules are arranged in a highly ordered and repeating pattern. This regular structure gives rise to distinct physical properties such as high thermal and electrical conductivity, optical clarity, and mechanical strength. The study of crystalline materials spans across various fields, including materials science, physics, and engineering. Notably, these materials are used in the development of semiconductors, photovoltaics, and advanced ceramics. The arrangement of atoms in crystals is often studied using techniques like X-ray diffraction and electron microscopy. The unique properties of crystalline materials are influenced by factors such as crystal symmetry, defects, and the size of the crystal lattice. This research continues to drive innovations in electronics, energy storage, and manufacturing processes.

Keywords:

Crystalline materials, crystal structure, X-ray diffraction, semiconductors, lattice, materials science, electrical conductivity, optical properties, material defects, energy storage.

NANO MATERIALS FOR GREEN REVOLUTION

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Abstract

The integration of nanomaterials into agriculture and environmental sustainability marks a transformative shift toward a greener future. These advanced materials enhance crop yield, improve soil health, and optimize resource utilization while reducing environmental impact. The Green Revolution is evolving into a new era driven by nanotechnology, where nanomaterials play a crucial role in sustainable agriculture, environmental conservation, and energy efficiency. Nanofertilizers and nanopesticides enable precise nutrient and pest control, reducing chemical overuse and soil degradation. Nanofertilizers and nanopesticides enable targeted delivery, minimizing waste and pollution. Nanomaterials in water purification ensure clean water for irrigation and human consumption, while nano-based sensors enhance precision farming. Additionally, nanotechnology aids in carbon capture and energy-efficient solutions, fostering eco-friendly industrial and agricultural practices. By harnessing the power of nanomaterials, the Green Revolution 2.0 can achieve unprecedented efficiency, sustainability, and environmental harmony.

Keywords:

Nanomaterials, sustainable agriculture, precision farming, Nanofertilizers, water purification, eco-friendly technology, Green Revolution 2.0.

SINGLE CRYSTAL

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ABSTRACT

Single crystal is a material in which the crystal lattice of the entire sample is continuous and unbroken to the edges of the sample, with no grain boundaries.The absence of the defects associated with grain boundaries can give monocrystals unique properties, particularly mechanical, optical and electrical, which can also be anisotropic, depending on the type of crystallographic structure. These properties, in addition to making some gems precious, are industrially used in technological applications, especially in optics and electronics. Although current methods are extremely sophisticated with modern technology, the origins of crystal growth can be traced back to salt purification by crystallization in 2500 BCE. A more advanced method using an aqueous solution was started in 1600 CE while the melt and vapour methods began around 1850 CE. Its has been used in microwave devices, surface science, solar cells, One of the most used single crystals is that of Silicon in the semiconductor industry. The four main production methods for semiconductor single crystals are from metallic solutions: liquid phase epitaxy (LPE), liquid phase electroepitaxy (LPEE), the traveling heater method (THM), and liquid phase diffusion (LPD). However, there are many other single crystals besides inorganic single crystals capable semiconducting, including single-crystal organic semiconductors. single crystals include silicon, aluminium, quartz, and fluorite.

KEY WORDS : *Crystal , mono crystal , mechanical, optical , anisotropic, crystallographic, diffusion , semiconducting .*

NANOTECHNOLOGY AND SENSORS

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Abstract

Nanosensors are chemical or mechanical sensors used in food and water quality detection to detect the presence of chemical species. Biosensor enabled packaging systems can detect food quality and extend shelf life. Nanosensors provide faster and more accurate detection of microbes, toxins, and adulterants. Nanoparticles may also be used to detect biodegradable food components such as vitamins and antioxidants. The review focuses on the emerging application of nanotechnology based sensors for shelf life analysis of food products, including freshness monitoring, food safety measurement, and detection of spoiled food components. The focused categories of nanomaterials for developing sensors in food applications are inorganic, organic, and carbon allotropes. In this context, the characteristics features of inorganic nanomaterials, organic nanomaterials, and carbon allotropes for developing nanotechnology-based sensors have been discussed. Further, a detailed discussion on the use of inorganic nanomaterials such as gold, silver, titanium dioxide, and zinc oxide nanoparticles for developing sensors in determining food shelf life (freshness, spoilage, and food safety) has been made. Due to available significant properties, including biocompatibility, nontoxicity, photochemical activity, large surface area, and electronic properties, the inorganic nanomaterials are a promising candidate for developing sensors to be used in food sectors. Besides, the inclusion of organic or biopolymeric nanomaterials and carbon allotropes for developing sensors for food shelf life has also been discussed. This study revealed that nanosensors have a substantial role in the food industry as identification and detection tool.

Keywords: Nanotechnology, Shelf-life, Inorganic nanomaterials, Organic nanomaterials, Carbon allotropes.

NANOFABRICATION

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Abstract

This literature review explores the advancements in nanofabrication Techniques, focusing on the two primary approaches: bottom-up and top-down Methods. Bottom-up nanofabrication involves the assembly and synthesis of Nanoscale structures from smaller constituent parts, highlighting techniques Such as self-assembly and atomic-layer deposition. The review discusses the Advantages and challenges of bottom-up approaches, including scalability and Reproducibility, along with their applications in nanoelectronics, nanophotonics, And nanomedicine. Conversely, top-down nanofabrication modifies larger Structures to create nanoscale features, with a focus on lithography Techniques such as photolithography and electron-beam lithography. The Review contrasts the strengths and weaknesses of both approaches and examines the potential for hybrid methods that leverage the benefits of each. Finally, the discussion emphasizes current trends and future prospects in Nanofabrication, underscoring its potential to drive innovations in fields such as Nanoelectronics, energy storage, and biosensing.

Keywords: *Nanofabrication, Bottom-up techniques, Top-down techniques, Self-assembly, Atomic-layer deposition, Lithography, Nanoelectronics, Nanophotonics, Nanomedicine, Hybrid Methods, Future trends.*

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