ISSN: 2157-7439
Journal of Nanomedicine & Nanotechnology
OPEN ACCESS Freely available online
Editorial

Nanomaterials the Future of Materials Science

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ABSTRACT

Nanomaterials have gained significant attention in recent years due to their unique physical and chemical properties, which make them useful for a wide range of applications. Their large surface area to volume ratio and quantum confinement effect make them highly efficient catalysts and useful in electronic devices, photovoltaic, and sensors. In medicine, nanomaterials have the potential to revolutionize drug delivery by improving therapeutic efficacy and minimizing side effects. However, the use of nanomaterials also raises concerns about their potential toxicity and impact on the environment, highlighting the need for careful evaluation of their risks and benefits. Overall, the future of nanomaterials is promising, and further research is expected to lead to even more exciting developments in various industries.

Keywords: Nanomaterials; Chemical properties; Catalyst and electronic devices; Photovoltaic; Sensors

INTRODUCTION

Nanomaterials are materials with at least one dimension less than 100 nanometres. They have unique physical and chemical properties due to their small size, which makes them useful for a wide range of applications. In recent years, nanomaterials have gained significant attention from researchers, as they have the potential to revolutionize various industries, including medicine, electronics, energy, and environmental science [1]. One of the main advantages of nanomaterials is their large surface area to volume ratio, which allows for enhanced reactivity and catalytic activity [2]. This property is particularly useful in catalysis, where nanomaterials can act as highly efficient catalysts, converting reactants into desired products with high selectivity and yield. For example, gold nanoparticles have been shown to be highly effective catalysts in the oxidation of carbon monoxide and the reduction of nitrogen oxides. Another unique property of nanomaterials is their quantum confinement effect. In nanomaterials, electrons are confined in a limited space, leading to the quantization of energy levels. This effect can lead to changes in the optical and electronic properties of the material, making them useful in applications such as photovoltaic, light-emitting devices, and sensors. Nanomaterials also have the potential to revolutionize drug delivery in medicine [3]. By using nanoparticles, drugs can be delivered directly to the affected area, minimizing the side effects and improving the therapeutic efficacy. Additionally, nanoparticles can be engineered to target specific cells or tissues, improving the selectivity of the treatment. In electronics, nanomaterials can be used to create faster and more efficient devices [5]. For example, graphene, a two-dimensional nanomaterial, has exceptional electronic properties, making it an excellent candidate for high-performance transistors. Similarly, nanowires can be used to create highly sensitive sensors and actuators due to their unique mechanical and electrical properties. However, the use of nanomaterials also raises concerns about their potential toxicity and impact on the environment. As nanomaterials are relatively new, there is still much to be learned about their potential hazards [6]. Therefore, it is crucial to carefully evaluate the risks and benefits of using nanomaterials in various applications. In conclusion, nanomaterials are a rapidly developing field with the potential to revolutionize various industries. Their unique physical and chemical properties make them useful for a wide range of applications, including catalysis, medicine, electronics, and energy. However, it is important to carefully evaluate their potential risks and benefits to ensure their safe and sustainable use. As research in the field continues, we can expect to see even more exciting developments in the future of nanomaterials [7].

PHYSICAL AND CHEMICAL PROPERTIES OF NANOMATERIALS

The physical and chemical properties of nanomaterials are significantly different from their bulk counterparts due to their small size, high surface area to volume ratio, and quantum confinement effect. Some of the important properties are. Surface area to volume ratio: The surface area to volume ratio of nanomaterials is much larger than bulk materials [8]. This increased surface area leads to enhanced reactivity and catalytic activity of the materials. Quantum confinement effect: Nanomaterials are so

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Received: 03-April-2023, Manuscript No: jnmnt-23-21152, **Editor assigned:** 05-April-2023, Pre QC No: jnmnt-23-21152 (PQ), **Reviewed:** 19-April-2023, QC No: jnmnt-23-21152, **Revised:** 22-April-2023, Manuscript No: jnmnt-23-21152 (R), **Published:** 29-April-2023, DOI: 10.35248/2157-7439.23.14.678.

Citation: Singh AK (2023) Green Synthesis of Iron Oxide nanoparticles using Neem leaf (*Azadirachta indica*) extract & it's Characterisation via UV-Vis Spectroscopy. J Nanomed Nanotech. 14: 678.

small that the quantum confinement effect becomes significant, which causes changes in the electronic and optical properties of the material. As the size of the material decreases, the energy levels of electrons become quantized, leading to a change in the material's properties. Size-dependent melting point and boiling point: Nanomaterials have lower melting and boiling points than their bulk counterparts due to their small size [9]. This property makes them useful in high-temperature applications. High strength and toughness: Some nanomaterials, such as carbon nanotubes and graphene, have exceptional mechanical properties, including high strength and toughness. Enhanced reactivity and catalytic activity: The high surface area to volume ratio of nanomaterials makes them highly reactive, leading to enhanced catalytic activity. Optical properties: Nanomaterials can exhibit unique optical properties due to their small size and quantum confinement effect. For example, gold nanoparticles exhibit intense color due to their surface plasmon resonance. Magnetic properties: Magnetic nanoparticles can exhibit superparamagnetism, which is a unique property that makes them useful in various applications such as magnetic data storage and biomedical imaging. Overall, the physical and chemical properties of nanomaterials make them useful in various applications, including electronics, medicine, catalysis, and energy [10]. However, their small size also makes them potentially hazardous, highlighting the importance of careful evaluation of their risks and benefits.

CONCLUSION

While nanomaterials have many promising applications, there are also potential risks and concerns associated with their use. Some of the main concerns are. Toxicity Nanomaterials may have different toxicity profiles than their bulk counterparts due to their small size, high surface area to volume ratio, and ability to penetrate biological barriers. This can lead to harmful effects on human health and the environment. Environmental impact: The release of nanomaterials into the environment, for example through waste disposal or accidental spills, may have unknown consequences on ecosystems and human health. Regulatory challenges: The unique properties of nanomaterials may require new regulatory frameworks to ensure their safety and efficacy. Ethical concerns: The development of nanotechnology raises ethical questions related to equity, justice, and potential unintended consequences. Public perception: The public perception of nanotechnology may impact its development and acceptance, particularly if perceived risks outweigh perceived benefits. To address these concerns, it is essential to conduct comprehensive risk assessments of nanomaterials, promote responsible development and use, and engage in transparent communication with stakeholders. Additionally, researchers and policymakers must work together to establish clear regulations and standards to ensure the safe and responsible development of nanotechnology.

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