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Applications of Gold Nanoparticles in Nanoscience

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Description

In recent years, there has been a lot of research on and interest in the field of nanotechnology. The rapid advancement of nanotechnology has led to a remarkable expansion in the production and application of nanoparticles (NPs). One of the most significant nanoparticles is gold (AuNPs), and due to its inert, biocompatible, and particularly low toxicity properties, they have been employed extensively for both medical and non-medical applications as excellent materials [1].

A vast range of pharmaceuticals that target and cure many common disorders, many of which are made from natural substances. These complex chemical molecules can be obtained from a variety of natural sources, including as plants, animals, microbes, and minerals. These compounds operate as a starter for subsequent sinker molecules. Gold is inert and widely acknowledged to be biocompatible [2].

For the numerous applications, the stability and dispersity of AuNMs in solution are crucial. The majority of inorganic nanomaterials require functionalization by thiols or surfactants to provide the stabilising forces because they are not well disseminated in physiological buffers. Furthermore, both imaging and in vivo medication administration depend on enough blood circulation time. One of the most important characteristics of AuNMs is Localised Surface Plasmon Resonance (LSPR). In Lateral Flow Immunochromatographic Assays (LFICA) and Enzyme-linked Immunosorbent Assays (ELISA), a well-established technology for analysis of the target analytes in food safety, clinical diagnosis, environmental monitoring, and medical science, among other applications, the AuNMs as reporters have been widely used. Au based nanomaterials (AuNMs) are recognised to have numerous desirable characteristics, including distinct electrical, optical [3].

The creation of designed, functional nanoparticles has led to significant advancements in the field of nanotechnology, which has become one of science's hottest topics. Many different metal nanoparticles have been used in a variety of medical purposes. Among them, gold nanoparticles (AuNPs) are particularly exceptional and are widely recognised to be driving an astounding resurgence. With their numerous, distinctive functional characteristics and simplicity of synthesis, AuNPs have garnered a lot of interest. The characterisation of the nanoparticles, such as their form, size, and aspect ratio, can be changed to affect their inherent attributes, including their optical, electronics, and physicochemical properties. They can be used for a variety of medical procedures, such as diagnosis, X-ray imaging, Computed Tomography (CT), medication and gene delivery, Photothermal Therapy (PTT), Photodynamic Therapy (PDT), and Radiation Therapy (RT) [4].

Since the SPR may increase the surface activity of AuNPs, it was used to characterise almost all of the medicinal uses and biological activities of AuNPs. The absorption spectrum of AuNPs exhibits a resonance band in the visible region due to the stimulation of SPR, whose amplitude, spectral position, and width can be altered by the variety of particle size and shape in the medium. Additionally, the SPR is highly influenced by both size and form. In-depth research and biomedical applications have been focused on functionalized gold nanoparticles with controlled geometrical and optical properties, including genomics, biosensorics, immunoassays, clinical chemistry, laser phototherapy of cancer cells and tumours, the targeted delivery of drugs, DNA, and antigens, optical bioimaging, and the monitoring of cells and tissues with the use of cutting-edge detection systems [5].

Conflict of Interest

None.

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