Versatility of the gold nanoparticle.

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Abstract

Gold is a noble metal, and it is commonly used because of its resistance to oxidation and electrical, magnetic, and physical properties. Forming gold into nanoparticles allows researchers to use gold in areas that are too small for bulk gold to reach and brings with it new capabilities. Gold nanoparticles have been utilized for centuries by artists due to the vibrant colors produced by their interaction with visible light. Gold nanoparticles, exhibit good chemical stability, and they can be surface functionalized with almost every type of electron-donating molecule including biomolecules. Gold nanoparticles are undoubtedly very versatile. Gold nanoparticles have played an important and severe role in medicine since ancient times. Also, gold nanoparticle is the most suitable for drug delivery applications. Drug delivery using gold nanoparticles, in combination with their intrinsic capability for photothermal therapy, should be explored in the future.

Keywords: Gold, Gold nanoparticles, Drug delivery.

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Introduction

Nano Science is a rapidly growing science. It has the size of one hundred nanometers or less which produce materials and devices of the same size [1]. It is used in fields like physics, biology, engineering, chemistry, computer, and others. Gold is a noble metal, and it is commonly used because of its resistance to oxidation and electrical, magnetic, and physical properties. Gold nanoparticles (GNP's) can also be synthesized from the reduction of gold salts by various reducing agents such as gallic acid [2].

Diagnosing of cancerous cell, QD's are coated with a protective biocompatible layer integrated with cancer fighting drug and antibodies to stick to the specific type of cancer cell. After injecting the QD in to the body, they go through the blood and finally attach themselves with the cancel cell using the antibody. After a certain time, as the cancer cell takes in the QD, the approximate location is radiated with infrared light [3].

Nanomaterials serve different purposes such as bioimaging, bio sensing, photothermal therapy, drug delivery. But most of their applications can be discussed in diagnostics and therapeutics. Common nanoparticles used in diagnostics are in the form of fluorescent particles (quantum dot and gold nanoparticle) plasmon resonant nanoparticles (gold, silver nanoparticle) and magnetic particles for MRI. In therapeutics, nanoparticles are used mainly for heat ablation of target tumors (photothermal therapy, photodynamic therapy), and delivery of drugs [2]

Gold nanoparticles (GNP's) have attracted great attention due to their unique electronic, optical, thermal, chemical, biological properties and their potential applications [2]. In this paper, I gave an overview of the origin of gold, the chemical and physical properties of gold, the nature of gold nanoparticles, properties of gold nanoparticles and research on gold nanoparticles [1].

History of Gold

Gold is one of the first metals to have been discovered; the history of its study and application spans at least several thousand years [2]. Gold was first used by Chinese, Arabian, and Indian scientists, who managed to obtain colloidal gold as early as in the V–IV centuries BC. The Chinese earlier used gold for medicinal purposes amongst other uses. They used gold and gold compounds.

Properties and Uses of Gold

Gold is a very rare substance that makes up about 3 parts per billion of the Earth's outer layer [4]. The rarity and property of gold have made it one of the most valuable natural resources on earth. Gold is a metal and it is associated with the following properties: good conductors of heat and electricity and are almost all solid at room temperature. In addition, gold is malleable and ductile. Gold is commonly used because of its resistance to oxidation and electrical, magnetic, and physical properties [1]. The oxidation range is from -1 to 5. Due to their small size (2-100 nm), they develop intense, long lasting colors and visible light emitting diodes, lasers, etc. [5]

Throughout history gold has had a wide range of use, even alchemists referred to them as an "Elixir of life" Chinese and Indians used it in medicine. For a long time, it was used as a drug called "nervin" for mental disorder [1]. From ancient times Ayurvedic medicine were widely used. They used gold and gold compounds [3]. Nowadays, gold pharmaceutics are actively being used in tumor problems.

Gold compounds are also being used in HIV, malaria agents and bronchial asthma as well. Gold drugs show anti-inflammatory properties. (Gold ash) is used for the treatment of bronchial asthma, rheumatoid arthritis, diabetes mellitus and nervous diseases [4]. It is of paramount importance for scientist to look to gold nanoparticles for medical applications rather

than using elements [1]. Forming gold into nanoparticles allows researchers to use gold in areas that are too small for bulk gold to reach and brings with it new capabilities.

History and Properties of Gold Nanoparticles

Gold nanoparticles have been utilized for centuries by artists due to the vibrant colors produced by their interaction with visible light. Modern scientific evaluation of gold nanoparticle began in the 1850's when Michael Faraday accidently a created a ruby red solution while mounting pieces of gold leaf onto microscope slides in the basement laboratory of Royal Institution [1].

Advances in various analytical technologies nowadays have accelerated the studies of gold nanoparticles (Figure 1). Advanced microscopy methods, such as atomic force microscopy and electron microscopy, have contributed the most to nanoparticle research.

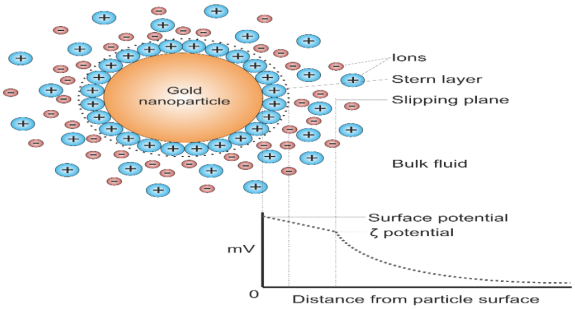

Figure 1. *Gold nano particles with ions surround.*

Due to their comparably easy synthesis and high stability, various gold particles have been studied for their practical uses [3]. Different types of gold nanoparticle are already used in many industries, such as medicine and electronics. **Gold nanoparticles** present distinct optical and physical properties, which are dependent upon their size (diameter), shape, surface structure and agglomeration state [6].

Gold nanoparticles exhibit a distinct optical feature which is often referred to as localized surface plasmon resonance (LSPR); LSPR is the collective oscillation of electrons in the conduction band of gold nanoparticles in resonance with a specific wavelength of incident light [2]. LSPR of gold nanoparticles exhibits a strong absorbance band in the visible region (500 nm-600 nm) (Figure 2)

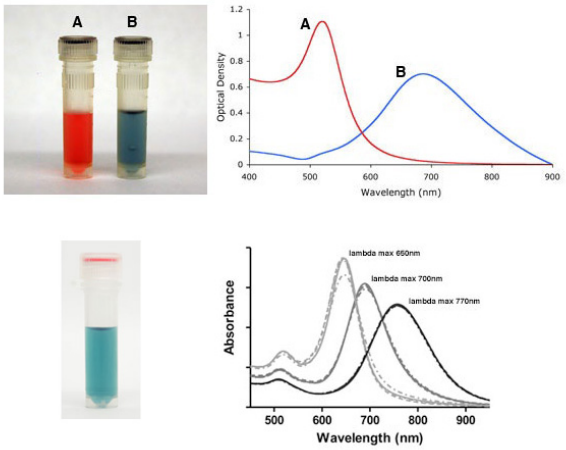

Figure 2. *UV-VIS spectra of gold nanoparticles.*

In Figure 2 Gold nanoparticle shape dependent localized surface plasmon resonance as indicated by the visual appearance and UV-VIS spectra of spherical (A), and urchin-shaped (B) gold nanoparticles (gold Nano stars). (Bottom) Absorbance spectra for gold nanorods with three different aspect ratios. Note the presence of two absorption peaks, which are caused by both transversal and longitudinal surface plasmon resonances.

Uses of Gold Nano Particles

Although Gold is a noble metal and is widely used because of its resistance to oxidation and interesting electrical, magnetic, optical, and physical properties; it forms many and diverse compounds [3]. Gold nano particles are biocompatible and easy to synthesize. Localized surface plasmon resonance (LSPR) of GNP is used to bio sense diseased cells. (LSPR) of a GNP depends on the environment, type, shape, and size. If we change the dielectric constants of the surrounding medium, then the resonant frequency changes [2]. So, when we have a diseased cell, the peak of LSPR shifts and provides us the information about the presence of disease or cancer cells [4]. In bioimaging, Gold nano rods and gold nano shells are very useful. Gold nano rods have been recently tested in mouse models [5]. Gold nanoparticles (GNP's) have been used as an additive to different drugs (passive medicine). GNP's can be used as a targeted medicine or can be used together with radiation in the treatment of cancer. GNP's with specific antibodies represent a promising alternative for the detection of antigens on the surface of cells. When gold nano sphere treated melanoma cell cultures are irradiated, the majority of cells containing the targeted nano spheres die, and nearly all those lefts are damaged beyond repair. Gold nano particles are effective fluorescence enhancer, (Figure 3) [4].

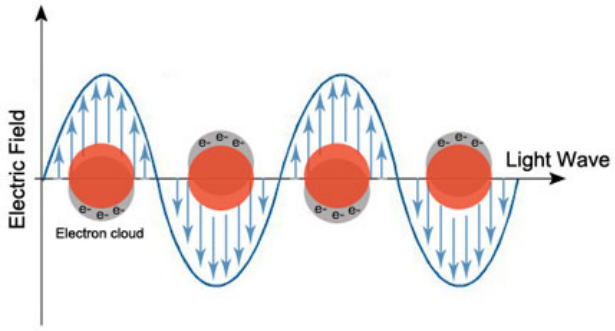

Figure 3. *Basics of localized surface plasmon resonance (LSPR).*

LSPR of gold nanoparticles due to collective oscillation of surface electrons with incident light at a specific wavelength.

Recent Applications of Gold Nanoparticles

GNP's is used in brain therapy as well. The human brain has a complicate and strange structure. It consists of trillions of inter connections between tens of billions of neurons [7]. Modern neuroscience is trying very hard tounderstand the circuits for neurology and brain's general health care [8,9].

Conclusion

Gold and gold compounds have played an important and severe role in medicine since ancient times. The use of gold in the medicines and research is made possible due to the existence of gold nanoparticles (GNP's). GNP's have shown a severe and great properties. It is capable of binding to viruses, antibodies, peptides, proteins, molecules. GNP's are uses in medicines, Biology, and Chemistry. GNP applications in science and medicines is growing rapidly.

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