OPEN ACCESS
Scholars Bulletin
Abbreviated Key Title: Sch Bull
ISSN 2412-9771 (Print) |ISSN 2412-897X (Online)
Scholars Middle East Publishers, Dubai, United Arab Emirates
Journal homepage: https://saudijournals.com

Subject Category: Physics

Potential Role and Recent Applications of Nanoparticles in Physics with Emphasize on Advanced Techniques

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DOI: 10.36348/sb.2021.v07i09.002 | **Received:** 25.07.2021 | **Accepted:** 01.09.2021 | **Published:** 06.09.2021

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Abstract

Different types of nanoparticles such as silver and gold can be evaluated at higher rate than those traditional methods or techniques. Nanoparticle Spectrometer is mostly used to measure the particle size distribution. Localized surface plasmon resonance is used for studying the shape, size and composition of the newly synthesized nanoparticles in order to extract the optical properties as different bimetallic nanoparticles. Nanoparticles can be synthesized through the pulsed plasma method by applying voltage across electrodes. Localized surface plasmon resonance is used for characterizing the physical as well as electrical characterizes of the some nanoparticles such as aluminum, gold and silver. Nuclear magnetic resonance is extensively used for determining of the atomic structure of different particles. Darkfield microscopy is used to find out the differences in contrast by selectively capturing light scattered by the specimen. Magnetic resonance in physics also used determination of the molecular structure of molecules bound to surfaces of nanomaterial. Liquid-phase plasma also applied for synthesis of nanoparticles in order to design the nanoparticles based on electrical and metal based properties.

Keywords: Nanoparticles, Physics, techniques, pulsed plasma method, Liquid-phase plasma.

INTRODUCTION

Nanoparticle spectrometer is used for detection of nanoparticles with accuracy and particle dimensions can be easily measured through the advances in nanotechnology [1]. Different types of nanoparticles such as silver and gold can be evaluated at higher rate than those traditional methods or techniques. Nanoparticle spectrometer is mostly used to measure the particle size distribution and surface area of aerosol particles over a range of 5 nm to 500 nm over 128 user-defined channels without the use of a traditional low-level radioactive source [2, 3].

Localized surface plasmon resonance is used for characterizing the physical as well as electrical characterizes of the some nanoparticles such as aluminum, gold and silver. The principle mechanism for localized surface plasmon resonance is the oscillation of the conduction electrons that generated the fine spectrum [4, 5]. The resonance that catalyzed the absorption and scattering cross-sections of silver and gold nanoparticles. This property of localized surface plasmon resonance for nanoparticles through oscillation leads to helpful for treatment of wastewater using the combination of other physical techniques such as optical thermometer [6, 7].

Darkfield microscopy is used to find the contracts property of some nanoparticles. Some traditional techniques are used but not reliable due to high cost and time consuming while on the other hand, Darkfield microscopy finds its applications to find out the differences in contrast by selectively capturing light scattered by the specimen. Magnetic resonance in physics also used determination of the molecular structure of molecules bound to surfaces of nanomaterial. It also helpful for evaluation of the size of different nanoparticles particles on the basis of resonance [8-10].

Typical Instrument /Target Application	Principle	Applications/Uses	References
Nanoparticle Spectrometer	It is used for detection of nanoparticles with high accuracy and particle dimensions can be easily measured through the advances in nanotechnology	Different types of nanoparticles such as silver and gold can be evaluated at higher rate	[1, 2, 3]
Localized surface plasmon resonance	It is used for characterizing the physical as well as electrical characterizes of the some nanoparticles. The resonance that catalyzed the absorption and scattering cross-sections of silver and gold nanoparticles.	Localized surface plasmon resonance is the most optical property of the bimetallic nanoparticles aluminum, gold and silver	[4, 5]
Magnetic resonance	It also used determination of the molecular structure of molecules bound to surfaces of nanomaterial.	For evaluation of the size of different nanoparticles particles on the basis of resonance, determining of the atomic structure of different particles	[9, 10]
Transmission electron microscopy	It is used for determination of the size and to investigate morphology	Different types of nanoparticles.	[11, 12]
Ultraviolet-vis	Ultraviolet (UV)–vis spectroscopy is used to study the optical properties and surface properties of gold nanomaterial’s	Optical properties and surface properties of gold nanomaterial’s	[13, 14]
Bimetallic nanoparticles	Bimetallic nanoparticles can be synthesized in order to designed the optical as well as magnetic properties.	Uses in different physics operational processes	[19, 20]
Liquid-phase plasma	Liquid-phase plasma also applied for synthesis of nanoparticles in order to design the nanoparticles.	For study the electrical and metal based properties	[32]

There are many other techniques that are used for studying the structural as well as functional properties of nanoparticles. These are nuclear magnetic resonance, transmission electron microscopy, optical spectroscopies such as ultraviolet UV-Vis spectroscopy. Nuclear magnetic resonance is extensively sued for determining of the atomic structure of different particles. Transmission electron microscopy is used for determination of the size and to investigate morphology while on the other hand, optical spectroscopies such as ultraviolet (UV)–vis spectroscopy are used to stud the optic properties and surface properties of gold nanomaterial’s [11-13].

Principles of Surface plasmon resonance in Nanoparticles

Light is absorbed when the energy from photon released as a result of inelastic phenomenon. Different types of oscillations that produced due to absorption as scattering of light phenomenon that leads to find the colorful detection of particles incorporated in nanoparticles coating surfaces [15]. Once the coating of nanoparticles damage due to electrical discharge other trouble shooting, colloidal solution remains on the surface of the nanoparticles in order to resistant the environmental changes [16, 17]. The frequency shift corresponds to the energy difference created molecular motion within the matter (molecular bond rotations, stretching or vibrations [18].

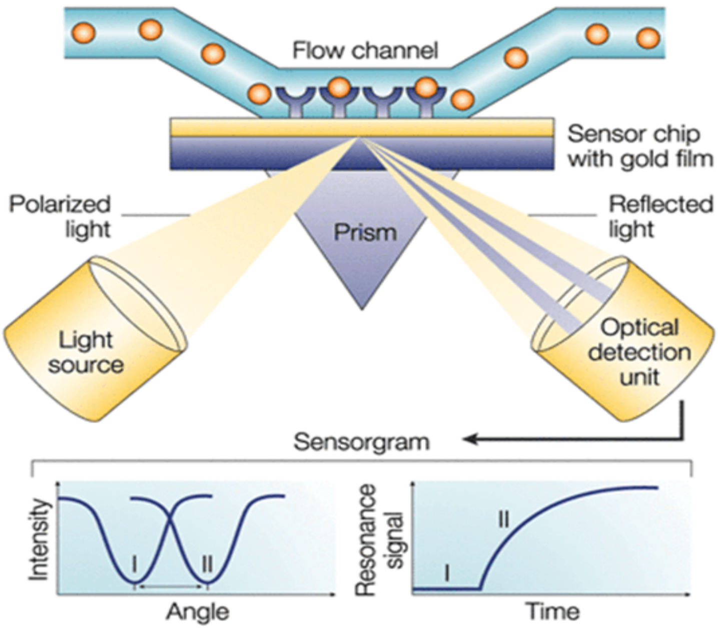

Fig-1: Shows the principle of Surface plasmon for nanoparticles synthesis

Optical & Physical Properties of Bimetallic Nanoparticles

Bimetallic nanoparticles can be synthesized in order to designed the optical as well as magnetic properties foe their uses in different physics operational processes [19]. Localized surface plasmon resonance is the most optical property of the bimetallic nanoparticles that usually attracts the oscillation of metals resulted the when the frequency of incident light matches the collective oscillation of surface electrons in the conduction band of the metal [20]. Localized surface plasmon resonance is used for studying the shape, size and composition of the newly synthesized nanoparticles in order to extract the optical properties as different bimetallic nanoparticles exhibits different absorption of light resultant the varying composition of nanoparticles [21, 22].

Role of Physical techniques for Nanoparticles Evaluation

Different nanoparticles exhibit the optical and absorption properties and their structures can be elucidated localized surface plasmon resonance. One of such kind of example is the copper nanoparticles that offers variety of applications in different industrial and commercial scale products such as cables, wires, electronics and other engineering operations as most dynamic tool for discovery of novel nanoparticles [23]. Bimetallic alloys consisting of 3d metals exhibit a high magnetic moment and have been reported to have the highest saturation magnetization values. Copper films on circuit boards as well as the ultra small connections on microchips are produced by discharging copper ions from solution with the help of an applied voltage. These applications helpful for characterization, synthesis and physical evaluation of electrical components based on the nanoparticles technology [24, 25].

Surface plasmon resonance also playing important role in designing of gold nanoparticles through the catalysis, photonics and remote sensing. Light is reflected and scattered from the sources of the nanoparticles in different directions due to surface plasmon resonance. It leads the occurrence of resonance that helpful for optical properties of different nanoparticles and early detection of defects in nanoparticles based wires and optically active devices [26-29].

Different types of nanoparticles can be synthesized through the surface plasmon resonance due to the optical properties as these helpful to light scattering process for large scale industrial processes. Nanoparticles can be produced into two categories either small or large. Smaller particles can strongly scatter the photon path, hence enhancing the electromagnetic field surrounding the particle. These nanoparticles can also make other industrial products such as wires and cables as in case of nano core shell or nanowires. The most compatible nanoparticles with low cost and high throughout put with electricity conductivity proper enhancing the advances in nanotechnology [30, 31].

Liquid-phase plasma also applied for synthesis of nanoparticles in order to design the nanoparticles based on electrical and metal based properties. This method leads to large scale production of metal oxides nanoparticles by controlling the size. Principles of reduction reaction using electrons and ions are employed for synthesis of metal oxides nanoparticles in order to enhance their electrochemical properties. Through this method, diverse metals diverse metals and metal oxide nanoparticles can produced through the process of imply by the reduction reaction using electrons and ions which are to be generated in an aqueous solution [32].

Silver- Mercury based nanoparticles are used nanoparticles in different in electrical equipment's. Silver- Mercury based nanoparticles can be synthesized employed the microwave assisted method with high quality nanoparticles can be obtained in larger quantities through the applications of laser. laser ablation of bulk materials in solution for producing NPs. Laser assisted method has several advantages over the traditional methods as no succeeding heat treatment required due to high energetic state of irradiated species [33, 34].

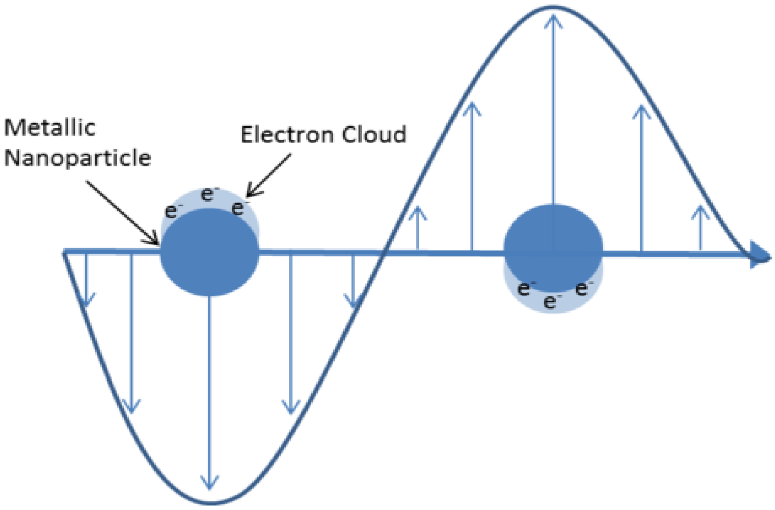

Fig-2: Shows the electronic cloud on metallic nanoparticles

Principles Methods for Synthesis of Nanoparticles

Silver nanoparticles as most commonly used nanoparticles in different physical operations like electrical equipment's and generation of energy from suitable renewable sources. Silver nanoparticles can be synthesized employed the microwave assisted method with high quality nanoparticles can be obtained in larger quantities through the applications of microwaves. It included the production of nanoparticles in two ways [35]. High conceptions of microwaves leads to defective synthesis of silver nanoparticles and low microwaves leads to insufficient nanoparticles. Only normal val can be produced silver nanoparticles. Microwave heating is better than a conventional oil bath when it comes to consistently yielding nanostructures with smaller sizes, narrower size distributions, and a higher degree of crystallization. Nanoparticles produced microwave assisted method leads to foundation for large variety of nanoparticles as compared to the traditional methods used in the past [36, 37].

Nanoparticles can be synthesized through the pulsed plasma method. In which as high potential voltage applied across the electrodes that fully submerged in the medium exhibiting the dielectric properties. It resulted the generation of plasma and this method leads the production of smaller nanoparticles less than 8nm and high quality achieved through this method ensured that plasmas resulting from ionization of neutral gases generally contain an equal number of positive ions and negative electrons, in addition to neutral, metastable, excited atoms or molecules and reactive radicals. This method is commonly impelled for designing the synthesis of smaller nanoparticles through propels of plasma submerged method and less chances of pollutants produced as a results of the generation of plasma [27, 29, 38].

CONLCUSION

Combinations of different nanoparticles can be produced through laser assisted method that is more convenient method as compared to the traditional methods used for conventions of different alloys. Plasma is used for synthesis of different compounds at industrial scale as it is the fourth state of the matter owing to its immense used in different fields especially for nanoparticles. This review helpful for synthesis of novel nanoparticles both commercial and industrial scale. It leads to the innovations in nanotechnology with advancements in physical sciences.

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