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introduction

Nanotechnology is going to be a main pushing factor behind the continuing technological revolution in the 21st century. Today, modernization is not limited to the tech sector development and its infrastructure, but also to the numbers of researchers, applications of nanoscience, in addition to Nanotechnology Characterization Laboratories (NCL), which have the potential of producing new materials and products that may revolutionize all areas of life.
Iraq, as a developing country, has suffered, for decades, from war and international isolation that have caused research and publication to fall behind in publishing high-quality academic articles, particularly in the cutting-edge area of nanotechnology, compared to other countries.

Hence, Al-Sibt center has set a distinctive goal to develop a research and establish a multidisciplinary journals managed by several academic professional and specialized industry experts in an attempt to bridge the research gap between Iraq and other developed countries. Consequently, the Iraqi Journal of Nanotechnology (IJN) is dedicated to publishing the most influential, innovative articles and applying some emerging nanotechnologies to areas fundamental to building technologically advanced and sustainable civilization ; including such diverse areas as:

- Synthesis and Self-Assembly of Nanostructured Materials, Films Functionalization, Size-Dependent Properties of Nanocrystals, and Quantum Dots and Nanowires.
- Processing and Templating of Nanotubes and Nanoporous Materials.
- Tailoring of Polymeric Nanoparticles, Organic-Inorganic Nanocomposites and Biohybrids.
- Fabrication of Nano and Micro Electro Mechanical Systems.
- Design and Engineering of Structural and Functional Nanomaterials.
- Nanosystems for Biological, Medical, Chemical, Catalytic, Energy and Environmental Applications.
- Nanodevices for Electronic, Photonic, Magnetic, Imaging, Diagnostic and Sensor Applications.

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Procedures For Dealing With Unethical Behavior , count.

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Arrangement Of Silver Nanostructures on Permeable Silicon and Examination of Their Optical Properties

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Keywords:
Nanostructures;
Silver;
Drenching statement;
Permeable silicon.

Abstract

Considers of nanostructures created beneath different modes of submersion testimony of silver on permeable silicon (PS) for their utility as dynamic substrates in monster Raman spectroscopy (SRS) are displayed. PS was shaped by anodizing monocrystalline silicon in an aqueous-alcoholic arrangement of hydrofluoric corrosive. The reflection spectra of the gotten silver nanostructures on PC have been examined. It is uncovered that to form ideal conditions for SERS spectroscopy utilizing silver nanostructures on PC, it is vital to utilize an energizing laser with a wavelength of 400–450 nm.

Introduction

Silver nanostructures on PS have interesting optical properties related to solid neighborhood electromagnetic areas emerging due to the excitation of plasmons on the silver surface [1, 2]. In this case, at certain frequencies of the occurrence radiation, the impact of localized surface plasmon reverberation (LSPR) is watched. Knowing the zone of LSPR sign, one can select the ideal modes of recording the SERS spectra, at which the concentration of the SERS flag will be greatest. SERS spectroscopy is utilized to distinguish and ponder the structure of the following sums of substances in science materials.

In expansion, the field of application of GCR incorporates biomedicine, environment, nourishment industry, legal science, and numerous others [5–11]. In this work, explored the regularities of the arrangement of silver nanostructures on PS and their reflection spectra.

Precipitation of condensation from the vapor (gas) phase refers to a group of methods for the deposition of thin films in a vacuum, in order to be characterized by the formation by direct condensation of steam, including under ultrahigh vacuum (at a pressure of <10 -6 Pa). Thermal evaporation method. From the melting point, the material to be evaporated is heated in a resistive way, by exposure to a high-frequency electromagnetic field, bombardment with accelerated electrons, a laser beam, and by means of an electric discharge.

The choice of a particular device is usually determined by a whole set of requirements. These are restrictions on cost, weight and dimensions, serviceability, availability, restrictions on environmental parameters (temperature, aggressiveness, humidity, etc., such as the need to pass through rolls), requirements for the output and indication of results, technical

parameters and characteristics, the need or absence of its packaging (for example, a moisture-proof or explosion-proof housing that protects against other radiation), the reception range, etc. From this point of view, the development of new detecting devices based on new physical effects and phenomena is of undoubted interest [3, 4].

Experimental part

Silver nitrate AgNO3 (99.9999%), 45% watery arrangement of hydrofluoric corrosive HF (45%), isopropyl (C3H7OH) and ethyl (C2H5OH) alcohols were utilized without extra Purification. Refined water was utilized to plan arrangements.

As the starting substrates, utilized single-crystal silicon wafers 100 mm in breadth doped with antimony, with a resistivity of 0.01 Ω cm and a crystallographic introduction of the surface (100). The surface of the silicon wafers was for starters cleaned from natural contaminants in a hot (75 ° C) smelling salts peroxide arrangement (Standard) and from the common oxide layer in a 4.5% fluid arrangement of hydrofluoric corrosive. At that point, the plates were dried by centrifugation. The PC was shaped by anodizing monocrystalline silicon in aqueous-alcoholic arrangements based on hydrofluoric corrosive. For the arrangement of PS layers, an electrolyte was utilized, which comprised of HF (45%), H2O, and C3H7OH blended in a volume proportion of 1: 3: 1. The anodizing handle was carried out at a current thickness of 100 mA / cm2 for 85 s. Such modes made it conceivable to get PS layers with a thickness of 5 μm, a porosity of 72%, and A normal pore distance across almost 100 nm. [5,6]

To get silver nanostructures on PS, PS tests were put in A fluid arrangement of AgNO3 with the expansion of ethyl liquor. The AgNO3 concentration changed from 1 to 10 mM, the statement time was 5 to 180 min, and the arrangement temperature was 20 or 40 ° C. After the arrangement of a silver film on the PC surface, the tests were altogether washed in ethanol and after that dried. The anodizing handle was carried out utilizing an AUTOLAB PGSTAT302N potential/galvanostat. The morphological and auxiliary parameters of silver nanostructures on PC were examined by filtering electron microscopy utilizing Hitachi S4800 gear. The reflection spectra were measured on an MS 122 spectrophotometer within the extend from 200 to 1100 nm.[7,8].

Results and discussion

According to the submersion statement component, it is known that the lessening of cations to their nuclear shape happens due to the expansion of electrons [9]:

$$Ag^+ + e^- \rightarrow Ag \qquad (1)$$

The sources of lessening electrons when utilizing silicon-based substrates are specifically silicon molecules. Due to the positive redox potential of silver, the cations of this metal are able of oxidizing the surface of silicon, taking absent electrons from it. Subsequently, when silicon is submerged in watery arrangements of silver salts, metal iotas are at the same time diminished (1) and silicon dioxide is shaped beneath them [9]:

$$2Si + H_2O \rightarrow Si\text{-}O\text{-}Si + 2H^+ + 2e^- \qquad (2)$$

Clearly, the long-term introduction of monocrystalline silicon in fluid arrangements of silver salts causes the arrangement of a nonstop layer of silicon oxide, which anticipates the contact of reagents from the arrangement and silicon iotas, which leads to the end of metal lessening. This limits the sum and consistency of the accelerated dissemination on the substrate indeed at a tall concentration of silver cations within the starting arrangement. Within the case of utilizing PS, a critical commitment to the lessening of silver particles is made by the nearness of Si-Hx bunches on its created surface, which

emerge as a result of the hydration of the bonds of silicon iotas, broken off amid the electrochemical carving of pores. Si-Hx bonds are profoundly responsive and effortlessly oxidized, moreover providing electrons for silver diminishment [9]:

$$2Si\text{-}H + H2O \rightarrow Si\text{-}O\text{-}Si + 4H^{+} + 4e^{-}. \quad (3)$$

In this way, PS plays the part of not as it were a forming substrate conferring nanoscale unpleasantness to the surface of a silver store, but too a source of a much bigger number of nucleation centers and electrons for the decrease of silver particles in comparison with single-crystal silicon.

X-ray diffraction investigation carried out for silver nanostructures on PC, arranged by the strategy of inundation testimony of silver on PC, appeared that the reflections watched within the diffractograms are characteristic of silver gems with the introduction (111), (200), (220), (311) 2θ (Figure1). That is, within the handle of inundation on PC, a polycrystalline silver precipitate was shaped. A solid reflection from the monocrystalline silicon substrate.

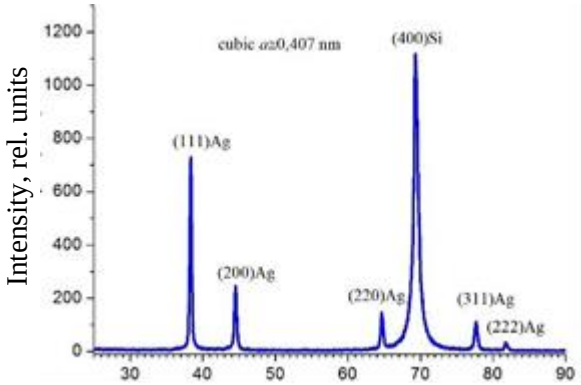
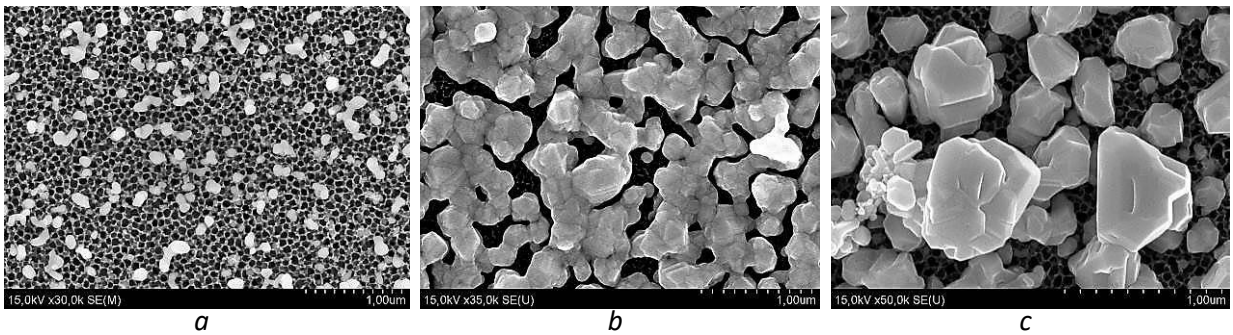


Figure 1. X-ray diffraction spectrum of silver nanostructure on PC

The regularities of the arrangement of silver nanostructures on PC. In Figure 2 appears SEM photos of the surface of PC tests kept in A watery arrangement of 1 mM AgNO3 and 1 M C2H5OH for (a) 15, (b) 120, and (c) 180 min at a temperature of 20 ° C. It can be seen that the beginning of silver testimony is organized and characterized by the arrangement on the surface of PS of isolated metal particles, transcendently circular, whose nucleation happens at the edges of the pores, which affirms the already depicted reality of expanded reactivity of locales of harmed silicon structure (Figure 2, a).



a *b* *c*

Figure 2.SEM images of the surface of PC samples kept in an aqueous solution of 1 mM $AgNO_3$ and 1 M C_2H_5OH for 15 (a), 120 (b), and 180 (c) min at a temperature of 20 ° C.

The breadth of silver particles ranges from tens of nanometers. Removal of 150 to 300 nm. A few of them joined

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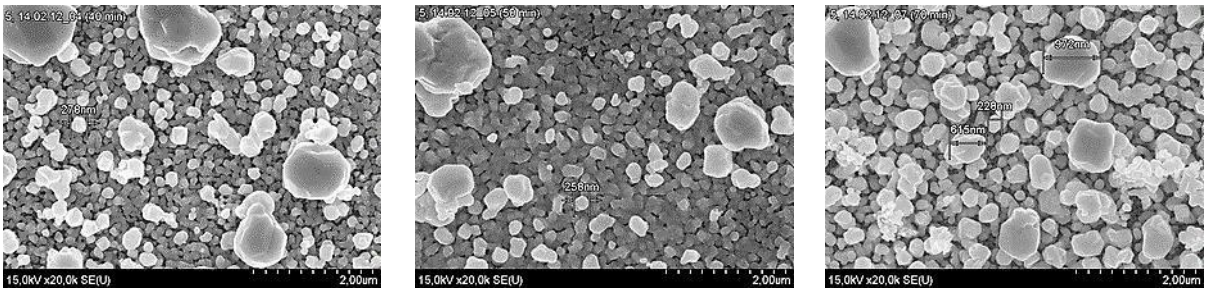
together into chains, which, upon assist holding the test in arrangement for up to 120 min, turned into sporadic agglomerates, somewhat consolidated with each other. Outwardly, the structure That appeared in Figure 2b takes after a permeable silver film, in which there are for all intents and purposes no independently found silver particles. The between the components of metal agglomerates that are not in contact with each other ranges from 30 to 100 nm, which is an arrange of size lower than within the case of 15 min statement. A longer inundation handles driven the development of silver agglomerates into expansive precious stones with an articulated faceting (Figure 2, c)[10].

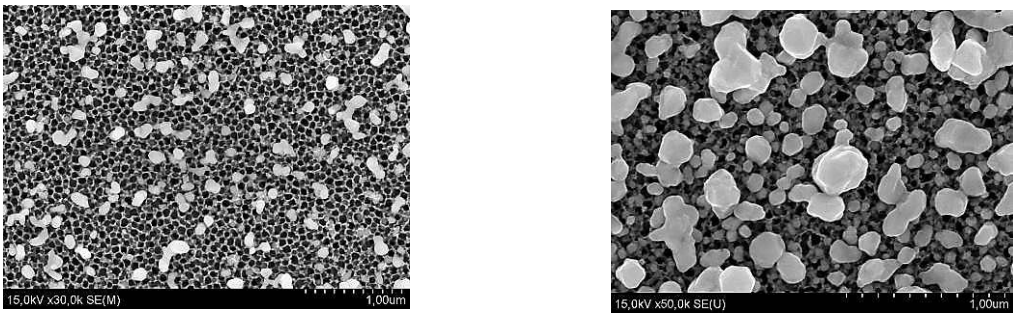
The watched wonder permits us to conclude that the drenching statement of silver on PS continues in understanding with the well-known Wolmer-Weber component, concurring to which the arrangement of lean movies happens as a result of the development of islands of matter, the strengths of interbank interaction interior which are higher than with the iotas of the substrate fabric. With an increment within the AgNO3 concentration to 3 mM, a similar pattern is Shown within the arrangement of a silver film on the PC surface: the move from the arrange of person particles (Figure 3, a) to the arrange of an almost persistent film (Figure 3, b), and after that the appearance of expansive silver particles and the arrangement of auxiliary islands (Figure 3, c). This affirms the prior conclusion of almost the statement component [11].



a *b* *c*

Figure 3. SEM images of the surface of PC samples kept in an aqueous solution of 3 mM AgNO3 and 1 M C2H5OH for 40 (a), 50 (b), and 70 (c) min at a temperature of 20 ° C.

Moreover in Figure 4 appears SEM photos of tests of silver nanostructures on PC arranged in a watery arrangement of 1 mM AgNO3 and 1 M C2H5OH for 15 min at a temperature of 20 ° C or 40 ° C. As can be seen from Figure 4, the instrument of silver testimony is the same as at 20 ° C, but the rate of the silver decrease response increments, which leads to quicker development of silver particles on the PC surface. In this way, for the same testimony time, a bigger sum of huge silver particles can be gotten.



a b

Figure 4. SEM images f the surface of PC samples kept in an aqueous solution of 1 mM AgNO3 and 1 M C2H5OH for 15 min at a temperature of 20 ° C (a), 40 ° C (b)

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The statement of silver at higher concentrations of AgNO3 and an expanded temperature of the arrangement continues agreeing to the same component. Examination of the reflection spectra. It is known that a critical increment within the SERS flag happens due to solid nearby electromagnetic areas that emerge close to metallic nanostructures upon the excitation of localized surface plasmons. In this case, LSPR is watched at certain frequencies, driving to a critical (resounding) upgrade of retention/scrambling of occurrence radiation.

Since PS substrates are dark within the unmistakable locale, the specular reflection spectra of silver nanostructures on PS were gotten in arranged to judge the position of the LSPR. In Figure 5, it appears the reflectance spectra of the tests shaped amid distinctive times of silver testimony at a concentration of 1 mM AgNO3. Within the long-wavelength locale of the spectra of silver nanostructures on PS, retention groups caused by the obstructions of light on PS are watched. In expansion, each of the reflection spectra contains two characteristic retention/scrambling groups within the interims 310–330 nm and 400–550 nm, related with retention/scrambling of radiation caused by LSPR in silver nanoparticles. With a longer silver statement time, the extend of measure scramble of metal particles increments, and their normal distance across moreover increments, which leads to broadening of assimilation groups in all reflection spectra and a move of their least to longer wavelengths [12]. With an increment within the AgNO3 concentration to 3 and 10 mM, the retention/scattering groups are within the same regions as at a concentration of 1 mM. There's moreover a broadening of the groups with a longer testimony and a move of their least to longer wavelengths (Figure 6, a, b).

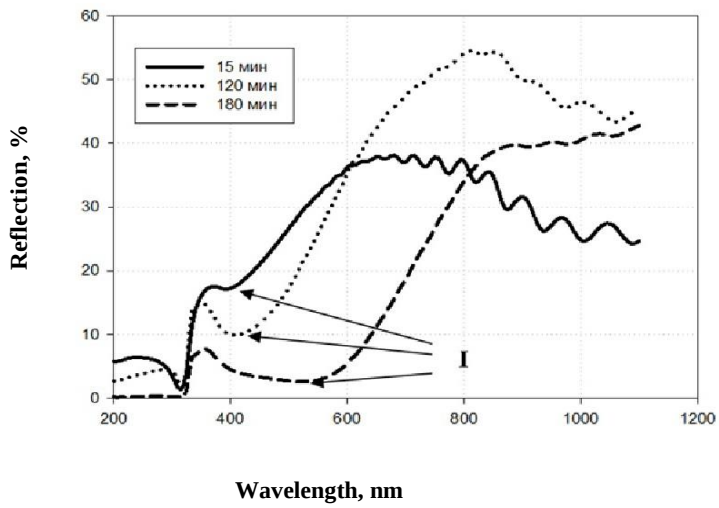
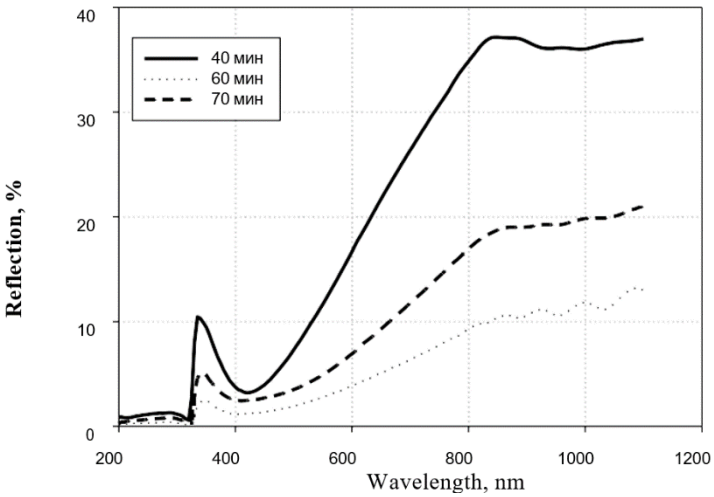
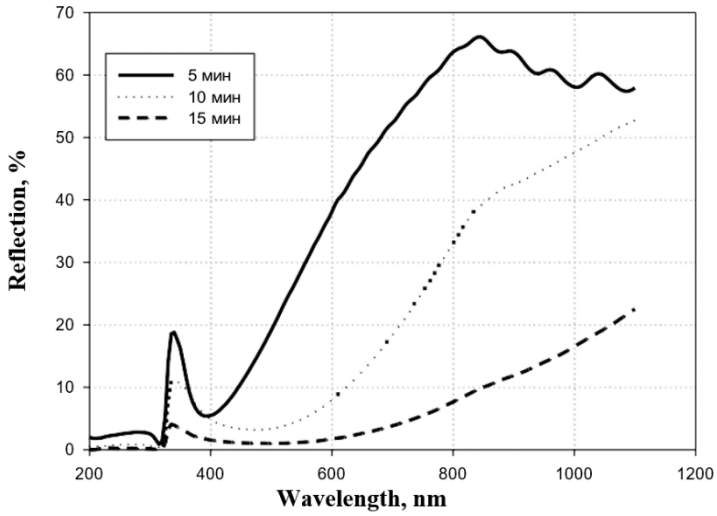


Figure 5. Reflection spectra of silver nanostructures on PS formed by deposition of Ag particles on PS from an aqueous solution of 1 mM $AgNO_3$ for different periods



a



b

Figure 6. Reflection spectra of silver nanostructures on PS formed by the deposition of Ag particles on PS from an aqueous solution of 3 mM (a) and 10 mM (b) $AgNO_3$ for different periods

Ideal conditions for SERS spectroscopy from particles adsorbed on the surface of silver nanostructures on PS will be made utilizing energizing radiation with a wavelength falling into the LSPR locale of these structures. Hence, to guarantee the most extreme affectability of SERS spectroscopy utilizing the silver nanostructures gotten in this work on a PC, it is fitting to utilize a laser with a wavelength of 400 - 450 nm.

Conclusions

By inundation statement of silver on PS from a watery arrangement of silver nitrate and ethyl liquor, it is conceivable to make silver nanostructures on PS, showing LSPR within the excitation wavelength extend from 400 to 450 nm. It is accepted that the gotten structures can be utilized for quantitative and subjective investigation of fluids by the strategy of

SERS spectroscopy. Additionally, the ideal conditions for SERS spectroscopy ought to guarantee they utilize an energizing laser with a wavelength of 400–450 nm.

Based on the results of experimental studies, the photoluminescence of the developed sensors was demonstrated at an X-ray flux with energy (E ~ 6 keV), a flux of γ-quanta from 10 to 20 rad / s, and a flux of UV radiation with an energy of the order of a few milliwatts at excitation wavelengths λex = 275 and 325 nm . Original solutions of constructive variants of sensors for detecting X-ray and ultraviolet radiation are protected by patents of the Republic of Belarus for utility models.

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Systematic Review of Internet of Nano Things (IoNT) Technology: Taxonomy, Architecture, Open Challenges, Motivation and Recommendations

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Keywords:
Internet of Nano-Things (IoNT);
Nano Communication;
IoNT architecture;
IoNT applications.

Abstract

Internet of nano things (IoNT) is a new and modern part of the internet of things (IoT). Applications that operate in the field of nano scale show a new advantage in communication networks. IoNT opened the door to many applications in various fields with new features derived from the advantages of nanotechnology. In this work, a description of the IoNT during 2015-2021 was achieved, including taxonomy, architecture, motives, applications and challenges, in addition to recommendations. The architecture of the IoNT and the most important technologies used in Nano communication networks have been identified, with an indication of the advantages of each. This study, we hope, will make a contribution to this field of science, thus contributing to providing assistance to researchers in this emerging field and covering the challenges they face in this way. That would permit communication between nano-devices to be conventional, making these calibrations to be implemented in various IoNT applications. Until the IoNT system is designed without any problems in the near future, which if achieved, will provide great services, especially in medical applications and other applications.

Introduction

IoNT is the field of nanoscale campaigns to the current communication networks. It is one of the requests of nanotechnology with the internet of things (IoT) technology, a combination of the two technologies. The drive of IoNT involves the dimensions to interconnect varied kinds of advanced devices that operate with nano communication network technique, where it permits the group of data in seats with hard admission [1, 2]. In the IoNT technique, multiple nano sensors will

connect internally with each other through nanonetworks [3]. Thus, it proposes a new model creating predominant networks that improve our daily actions that will recover communication efficacy and rise the communication stations' character and its abilities with minor costs. Temporarily, it protects greater ranges and realizes the unfamiliar and difficult to admission spaces at the molecular level [4]. Most of the critical difficulties have become possible to overcome using this technology, and applications such as reading data based on portable sensors have become available through this technology [5]. The most important factors in the development of IoNT technology are based on low-cost processing capabilities compared to huge storage capacities, as well as smart antennas and smart RFID technology [1]. In this study, the keywords related to this topic have been searched in a systematic way as follows:" Internet of nano things", or "IoNT", or "Nano things" AND "Communication" or "Sensor". The selected digital databases for this study were described as follows: ScienceDirect, IEEE and Web of Science (WoS) database. The research time range is achieved within the years (2015–2021) adopting the English language only. The obtained literature sources are screened and filtered by excluding duplicate articles. The results of the original query exploration of 352 articles were done as follows: 6 articles from ScienceDirect, 10 articles from IEEE and 11 articles from WoS from 2015 to 2021. The final set involved 27 papers, which were separated into two main groups. The first group, which includes 13 articles were reviewed and surveyed. The second group was IoNT architecture limited to 14 articles in three units. The first unit, which covered 8 out of 14 articles, were the IoNT based nano sensor techniques. The second unit, which covered 3 out of 14 articles, described the IoNT gateways, while the last unit included IoNT based servers which covered 2 articles. These results are summarized in figure1.

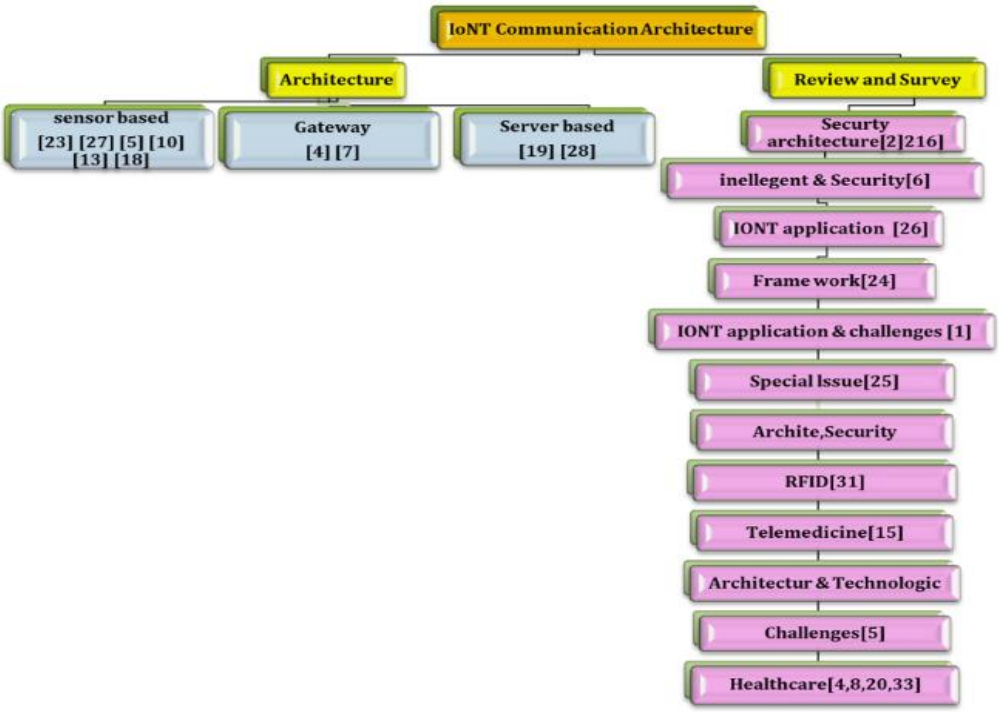

Figure 1. Classification of articles about IoNT technology. The first part includes review and survey, while the second dealt with IoNT architecture which is categorized by three areas: sensor, gateway, and server.

In order to identify the levels of publication for the aforementioned search engines, the number of articles published during the specified time period was counted, as shown in figure 2. It is very clear how much new topics are understudied in important scientific sites.

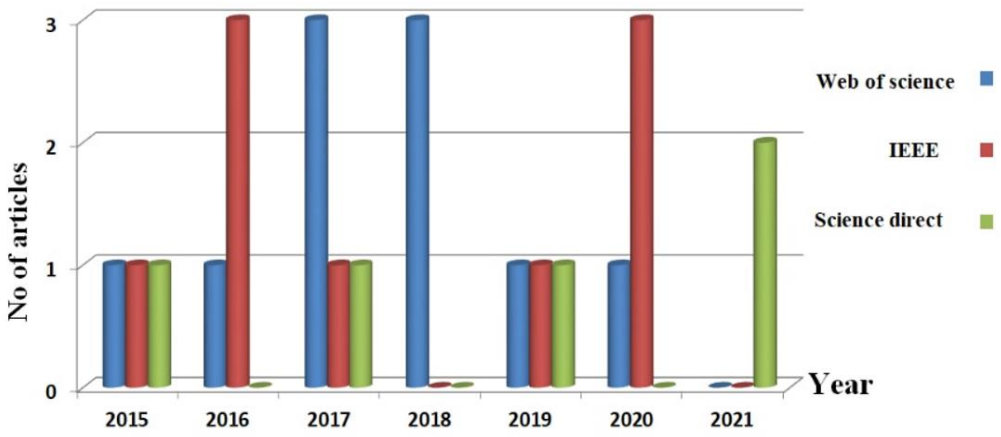

Figure 2 The publication level of IoNT literature through the three search engines during the period 2015-2021, the diagram indicates the low level of publication during this period and the need to increase interest in this topic.

Reviews and Surveys

In [6], several IoNT technology gates were produced to achieve access to one or more nanonets, ensuring accurate processing and reliability. The intended IoNT health care applications with the requirements are recognized by [7], as well as the fundamental health care facility chances. While [8] was studied In-Body Nano Communication Network with the Body Area Network of the IoNT architecture by an overview and major requirements to design gateways. This studied model forms a new level of security where the authors assessed the resultant security challenges with processors. Another study examined the effect of some changing environmental conditions and observed their effect on IoNT communication based on molecular contacts, namely temperature (T) and the relative concentration of physical obstacles (X). When the conductivity (Pconn) of the nano-network was examined, it has been noted that Pconn was less affected when changes occur in T and X [9] while increasing T had a positive effect on the Pconn in the case where there is an interference in the received signal. In [10], the IoNT based telemedicine application was analyzed and the medical information contained in the international publications was obtained, processed, and distributed.

The authors, in [11], have proposed the eNEUTRAL model to monitor the energy factor through the IoNT, which detects and introduces signals about the event that depends on the amount of energy generated by the events. As a result, data will be uploaded to a control location depending on the energy obtained from the event. A new approach in nano grids based IoNT that reduces energy consumption within the grid is an Enhanced Energy-Efficient Algorithm (E^3A) which was proposed by [12]. A new approach named a rational data delivery approach (RDDA) was designed by [13] to provide the extended network lifetime without affecting other QoI features within the IoNT. In [14], a proposal was presented to address the energy problem in the IoNT communication system, this proposal includes synchronization of wireless information and nano-networks which transmit energy in the terahertz (THz) range to ensure improved system performance. The applications, challenges, security objectives, attack cycles, and security challenges of the IoNT network were investigated

by [15]. A system was developed in [16], to harvest energy through a combination of nano-antenna and ultrafast modulated diode to overcome the challenge of extremely limited power in IoNT networks when used in healthcare applications. This device acts as a generator in the system depending on the broadband characteristics that enable it to generate direct current (DC) with a power of 27.5 nW from input with THz to optical frequencies, which provides low voltage compared to the piezoelectric nanogenerator. The energy problem was also studied by [17] by proposing a system that saves energy using only one short pulse. This system is based on the use of a Uniform Linear Array (ULA) antenna.

A previous study on the meanings, features, and potentials of IoNT are introduced by [1]. This review provides an explanation of the present state of IoNT, technologies, applications and challenges. In order to address the security issue in IoNT, a security model has been proposed by [2] that establishes two levels of communication: the first is based on electromagnetic waves; while the second is based on a molecular conversation. A mathematical model that contributes to the development of transport policy in IoNT technology has been proposed to address some of the limitations [18] by proposing the General Markov Decision Process (MDP) model. It will contribute to reducing the economic cost of this technique and reducing the damages of implants inside the body. Routing protocols have been studied within the IoNT as well as wireless Nano sensor networks WNSN by [4], which contribute to the expansion of the coverage through its integration with the other nano-devices. Another IoNT design included security challenges that have been introduced by [5], the smart communication models due to the increasing number of connected devices which contribute to medical applications were discussed. In [3], the applications of IoNT to modern health care were studied carefully. A comprehensive overview of this technology and an explanation of the communications architecture for IoNT in Healthcare have been provided. By leveraging on the advantage of security advances in the radio physical layer (PLS), the authors in [19] proposed an encryption technique in order to deal with the security challenges of IoNT. This proposal contributes to facilitating the work of the system within a safer environment.

The various layers in IoNT have been studied by [20] with the most important health care applications such as medicine delivery and disease detection. Another study [21] to address the problem of limited energy was conducted because of the size of the nano-nodes during the environmental and medical applications of IoNT. The effect of air velocity and circulation on nano-components has been studied. In [22], improving the intensity of the focused electric field in the nanoantenna of IoNT design as well as increasing its bandwidth was studied. A proposal to solve the lack of microscale communication sub-systems to enable connectivity between individual nanomachines for IoNT was introduced by [23] by using a synthetic molecular communications (SMC) modulator to link the macroworld to the microworld. Finally, the IoNT-based information architecture was developed by [24] based on a vision-oriented concept.

IoNT Architecture Techniques

There are two areas of IoNT: The Multimedia Internet of Nanoscale Things (IoMNT) and the Internet of Nanoscale Bio-Things (IoBNT). Both are the interconnection of nano-devices with existing communication networks. The architectures of the IoNT network depend on the application domain and its specific features. The most important basic components involved in the architecture of the IoNT network are: Nano nodes, nano routers, nano-micro interface devices (gateway), and internet portals [2,4]. The properties of the nanomaterials embedded in the nanodevices (such as graphene nanoribbon (GNR) or carbon nanotubes (CNT) have an important role in making IoNT design challenges. Gates are Wi-Fi access points that provide a specific location of a patient’s place, or the location of a patient's smartphone [3].

The IoNT architecture integrating intrabody nano communication networks with body area networks are shown in figure 3. In this architecture, the nanodevices are distributed in groups, and each group has a group boss who handles the data and sends them to the nano router within a dynamic path that changes according to the setting and availability. These nano paths ingeniously link to the nearest gateway to transmit information. The nanodevices are then connected via networks that are physically separated from each other [3].

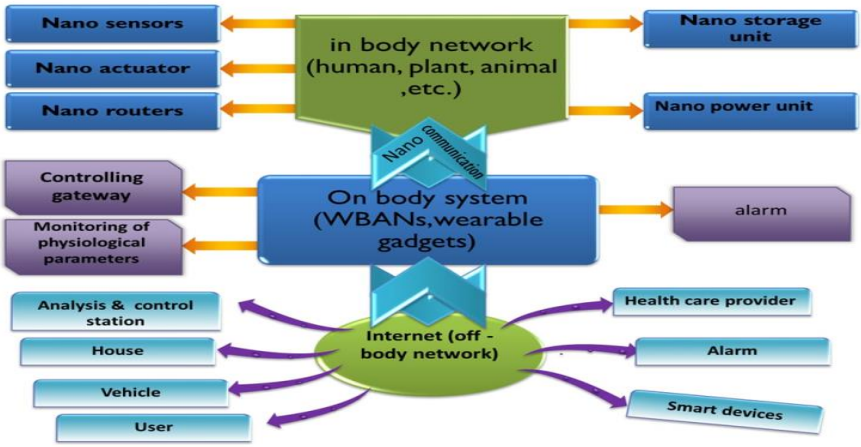

Figure 3: The general IoNT architecture integrating intrabody nano communication networks with body area networks. All communication features are provided through this architecture, implementing various medical applications, storage and processing feature as well as in other applications such as factory work tracking system.

The main nanodevices based IoNT architecture are: sensor and actuation unit, processing unit, a communication unit, storage unit, and power unit [4]. Off-body systems are pervasive from the point of view of the individual, home, car, road, or clinic. These systems can provide extensive health monitoring services. There are three nanonetworks in IoNT architecture depending on the location of the nanodevice: [3]

- On-body systems: they are distributed wirelessly to the same object. View WBANs and wearable tools are used to analyze the received data as well as quickly send health services from and to the private space inside the body.
- In-body systems: they are regularly distributed in different areas within an individual's body, either connected or entrenched in smart screening tools or as internet-connected nanodevices [6].

IoNT Architecture Techniques

IoNT communication utilizes one of these two communication techniques:

- Molecular communications (MC) technique: The transmission and reception information are formed in molecules in this technique. Data are encoded either as a center or as a type of transmitter particle. Messenger particles can be used to hold data through a medium, such as air or liquids. In any case, these atoms are extremely suitable for short-range communications, for example, communications in BANs. The MC technique can be used to create communication systems based on chemical reactions and transport processes, especially those of basic organisms [25].

- Electromagnetic communications (EM) technique: In this type, the transmission and reception of electromagnetic radiation is achieved within the terahertz (THz) range (0.1 THz - 10 THz), which provided super-fast data transfer within IoNT. Data are also exchanged inside and outside the body based on molecular radio communications, audio, or radio frequencies in the terahertz range [6]. Table 1, offers a comparison between these two techniques.

Table 1: Comparison of the different characteristics between each of the molecular communications (MC) and electromagnetic communications (EM) technologies.

Communication Channel	Speed of Information	Physical Data Rate	Environmental Conditions Influence	Activated Molecules	Path Loss	Remote Attacks
Electromagnetic	faster	high	less	more	heavy losses inside the fluid	may occur
Molecular	slower	low	more	less	Less losses inside fluid	may occur

Applications of IoNT

IoNT technology has many promising applications that researchers mentioned in various fields based on the advantages of this modern technology, which has a great impact on various fields in the future.

- Health Care Monitoring

  Nano sensors can be used in health applications through monitoring; where they can monitor most conditions such as temperature, pressure, sugar, fats in the blood and the like. These sensors can also be used to detect cancerous tumors, etc. [10]. In addition, nano sensors can be used to treat nerve cell damage by locating the affected area and using the myelin sheath. IoNT's nano sensors transmit the nerve impulse signal, although this is difficult with other technologies [26].
- Environmental Monitoring

  Most important places such as train stations, airlines, nuclear reactors and other sensitive places can be monitored using this technology. In addition to following up the traffic of cars more efficiently than before, with the follow-up of the pollution rate in the air, and the observation of climate changes and temperatures with extreme accuracy [1].
- Precision Agriculture

  IoNT technology can be used in agricultural applications by building nano-systems that are capable of resisting agricultural pests with high efficiency, which leads to increased production and availability for various species [2]. This technology is also used to monitor agricultural crops through nano-control systems that supervise the stages of plant growth and control them from a distance. Knowing the climatic and environmental conditions and other

factors such as the condition of the soil and other cases [6]. These data can also be sent to follow-up and monitor stations to take appropriate steps and address emergency cases [26]

- Military

  IoNT technology can perform many services with the development and diversity of the weapons industry, such as the presence of chemicals which can be sensed with high accuracy, and the durability of civil and military constructions that can also be examined and infinitesimal defects can be detected. In the field of telecommunications, the IoNT based on THz offers higher capacity with higher throughput, and can rapidly exchange information by integrating nano tools into advanced cell systems related military applications.

- Industrial

  Industries can be improved with IoNT technology in different fields. Nano sensors can be used to develop remote sensing devices, and the RFID technology is used to identify some industrial components that can be replaced by IoNT technology as data can be transmitted in huge quantities and at high speed through the Internet. Other areas that can be developed using this promising technique are mentioned in [27].

- Smart Cities

  IoT technology plays a distinctive role in the formation of smart cities by communicating with various households and other devices. However, IoNT technology can provide these systems with high-precision nano-sensors and huge storage capacities, which contributes to the development of infrastructure for smart cities, the provision of means for detecting pollution in the atmosphere, the contribution of the economy and providing different facilities [10].

- Oil and Gas

  IoNT provides a great opportunity to locate underground oil with high accuracy by taking advantage of the properties of nano-sensors. The traditional method used to detect oil locations is considered less efficient than this technique because it relies on a large magnetic field and a receiver within a specific system to send the nanocomposites to the specified place.

- Biomedical Applications

  The most important application based on IoNT technology is the biological applications due to the convergence between nanoparticles and living cells in terms of size, as it is possible to simulate living cells through this technology. It can also be used in many vital applications, for example using nano sensors that can be implanted inside the body or injected into the blood to monitor damaged cells, heart cells, etc., and to diagnose harmful cells, or in other medical applications.

- Functionalized Materials and Fabrics

  Using IoNT technology, it is possible to develop materials and fabrics with modern features that contribute to performing new tasks in the textile industry, such as contributing to the development of antibacterial textiles as well as the manufacture of spot pesticides by taking advantage of the advantages of nanomaterials. In addition, IoNT technology can be employed to realize the possibility of adding certain properties to textiles by taking advantage of IoNT technology to create smart textiles with new technologies. These applications have been indicated in figure 4.

Figure 4: applications of IoNT

Challenges of IoNT

This section provides an overview of the most common challenges based IoNT technology. Since IoNT technology operates within the nanometer scale, this feature, despite its enormous benefits and promising applications, produces many challenges that should be studied by researchers to develop solutions in order to enable this technology to provide its better services to humanity in a way that it is safer and less harmful to societies. Among these challenges that have been studied are the challenges of linking body region networks and other extrinsic gates to nano-devices inside the body by [6]. The challenges of data transmission in IoNT technology are also briefly studied in [3]. The challenge of promise high throughput for distributed scheduling algorithms while maintaining low average delay has been covered by [28] with the challenge of permit data to be carried within hard limits before being released at the time the next package reaches. Below are some of these published challenges:

- Security of IoNT Technique

  One of the most important challenges based IoNT technology is the problem of security and privacy during the work of this technology, which has wide and sensitive applications, as it enters the human body in addition to its work outside it, which increases the sensitivity of the information transmitted by this technology and its need for safety to preserve lives and property. Since IoNT operates within terahertz limits, this requires new security measures compatible with this technology to prevent data theft and harm to users. Among the most important security challenges, according to [6] are eavesdropping and data theft, attempting to disrupt treatment injection procedures, and altering links of nano communication level or a BAN gateway.
- Privacy

  The threat of data theft that IoNT deals with, as a result of its integration with other applications, are phones, home appliances, and the like as these data can be threatened, especially when they are connected to the internet.
- The Nanoscale Communication

There are challenges facing the implementation of this technology, including those related to the nanoscale size of IoNT devices, which require redesigning and developing new communication models and network concepts that are compatible with these components. Where the terahertz range of frequencies between 100 GHz and 10 THz needs to be studied and modeled for its application on the ground. Figure 5 describes the challenges based on IoNT.

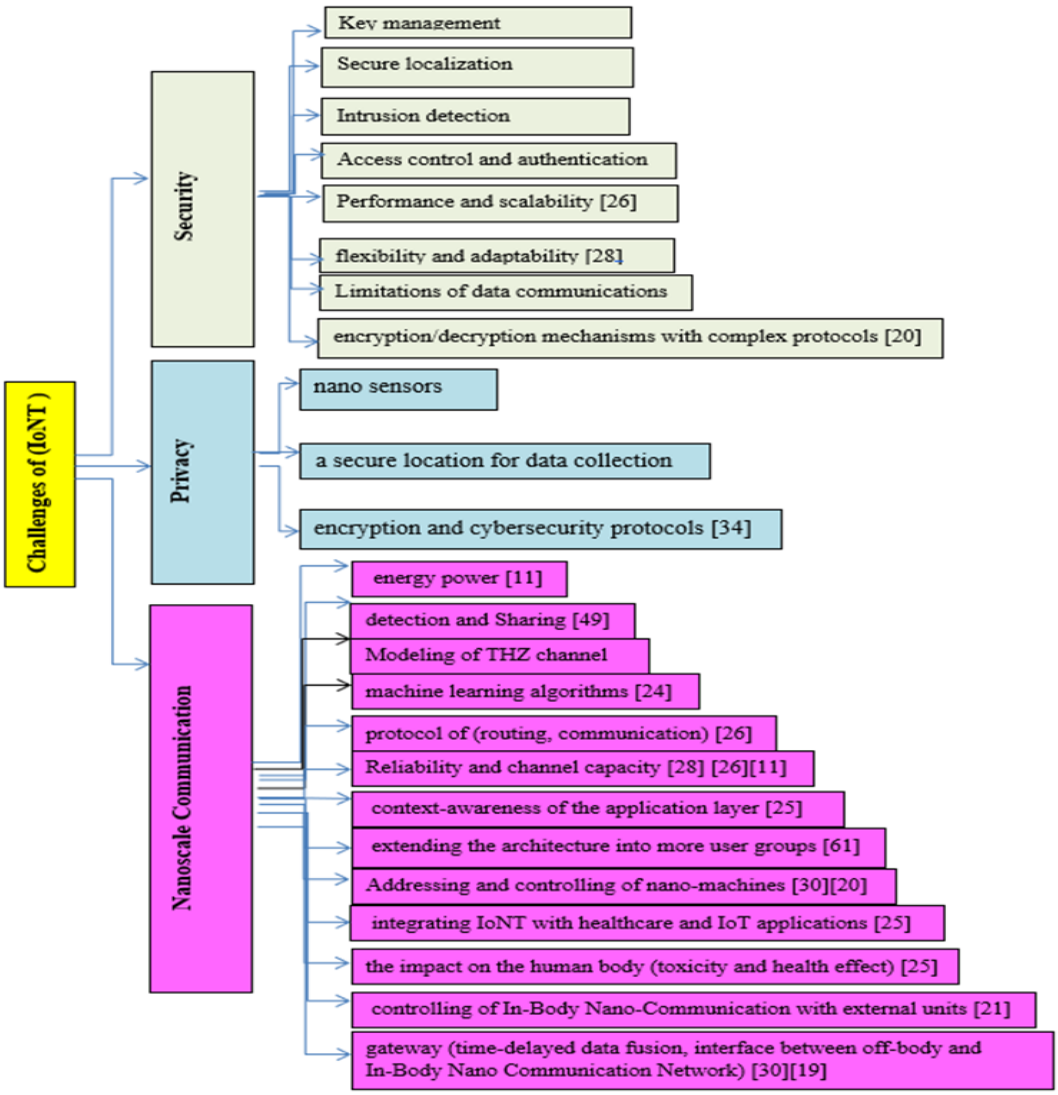

Figure 5: diagram of the current challenges based IoNT technique

Recommendations of IoNT

In this section, a number of recommendations mentioned by researchers for the purpose of developing IoNT technology in the near future, have been mentioned to overcome the challenges based this topic, such as technical problems related to devices for various medical uses.

- Conducting a study based on the data collected from users of different ages, places and genders to determine the security problems in data transfer and their expected effects on the individual and society [29].

- Developing efficient machine learning models through IoNT technology.
- Focusing on IoNT industry applications [1].
- Studying the expected impact of IoNT technology on economy.
- Studying THz based imaging systems.
- Integrating advanced deep learning methods during the study of IoNT in order to develop its performance [30].
- Additional reducing the energy ingesting of forced IoNT nodes by preserving the complete time using a small, portable device that sends time and supplies power-collecting circuits to the nodes [31].
- Investigating the use of IoNT and IoT along with BC for making DMS [32].
- Seamless integration of IoNT with existing IoT systems and networks in health applications [7].
- Investigate security and computing power issues in IoNT technology [24].
- Developing a system to get optimal Pconn under flexible environmental situations [9].
- Integrating MEMS Nano plasmonic surfaces with numerous projects to realize high-performance transmission, reception and dispensation optical signal on a single microsystem on a chip for growing IoNT applications [22].
- Building a self-charging energy system based on the principle of frictional nanogenerators to meet the distributed energy needs of the IoNT network [33].
- Development of an IoNT system in the biofield by coupling paper-based chitin (ChNF) sensors to smartphone technology [34].
- Construction a imitation model of rectilinear devices based on carbon nanotubes (CNTs), and nano-array technology to wirelessly power nano sensors [16].
- Positioning and categorizing different actions in the IoNT when several event nano sensors sense and convey pulses concurrently [17].

Conclusions

In this work, a systematic review in the IoNT techniques was investigated. Also, a review and survey, architecture, communication techniques, applications, challenges and recommendations related to this technique have been presented. The field of study described in scientific engines cab be described as follows: Science Direct, IEEE and Web of Science (WoS) database. The research time range was achieved within the years (2015–2021). The results showed that there are just 27 articles in IoNT techniques during these engines, these articles included 13 articles about review and survey and 14 articles on which IoNT architecture based nano sensors, gateways and servers. IoNT technology needs more attention from researchers in this field. It was concluded that there are wide application areas for this technology in various fields, and there are also many challenges that need more attention in addition to some future recommendations. The results showed that this technology is very useful in developing many scientific and applied fields in the future.

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Cloud Point Extraction with Liquid Ion Exchange for the Separation and Determination of Magnesium (II) as anion

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8-Hydroxy quinoline;
K417G;
Cloud point extraction;
Janus green;
Ion Exchange.

Abstract

Liquid Ion Exchange joined with Cloud point extraction methodology was used for the separation of Magnesium (II) from aqueous and determine whereas 10 mL aqueous solution that contains 50 µg Mg^{2+} ion is complex with 1×10^{-3}M 8-Hydroxy quinoline (8-HQ) at a suitable basic medium it well give higher extraction efficiency at optimum conditions, needs heating the aqueous solution in suitable temperature degree for enough time to form a cloud point layer (CPL). Therefore, the optimum conditions that yielded the good CPL have a small aggregation volume which is appropriate for continuing the ion pair association Complex between Magnesium ion and 8-Hydroxy quinoline.

Introduction

The cloud point extraction method has been widely used in recent years due to the high susceptibility of this technique and its high efficiency in extracting many elements, as well as the diversity of surfaces that can be used well and meet the desire of the chemical analyzer to obtain a quantitative extraction from many different elements, and from these elements, Cr(VI) by using Triton X-100 as an active surfactant [1]. It was used to extract Fe (III) from different geological samples [2], Fe (III) ions after complexation reaction with organic reagent Zincon at pH [3]. It was also used to remove nanoplastics (NPs) pollution from environmental waters by using Triton X-45 as an active surfactant [4] which can be used to determine many different compounds such as alkaloids, medicine drugs and organophosphorus from complex matrices [5]. Besides, it was used, for the first time, to detect Cu (II) after the formation of a complex with complexing agent compound N-benzamido-N'-benzoylthiocarbamide[6]. Co (II) can be separated and extracted by applying this technique to separate and determine the metal ion from the real samples in the presence of Triton X- 100 as an active surfactant [7]. The extraction and determination of phosphate compounds at room temperature can be achieved by applying cloud point extraction procedures from water samples [8]. This procedure has used Triton X-114 to produce a suitable cloud point layer that was used to determine the Level of Nanoparticles Ag_2S and ZnS in Environmental Waters [9].

Oxine anion is the main organic reagent used to form complex after being combined with Magnesium (II) and, afterward, being electrostatically bound with Rhodamine-B^+ to give an ion-pair association complex. Then, this complex was to be separated into a Cloud point layer (CPL) to determine Magnesium (II) spectrophotometrically at a wavelength of maximum absorbance that was 648nm, in addition, to using Triton X-100 for the sake of separation and determination.[10]. The onium method was the method this study depends on to use with cadmium (II) for the processes of separation and determination of different samples. The optimum conditions for application have illustrated the maximum absorbance for species at a wavelength of 260 nm. The Onium species needed 0.5M from HCl to form Onium species in the aqueous solution which contained 50µg/5mL of Cd^{2+} in presence of 2,4-dimethyl-3-pentanone as an organic reagent.[11]. Trace amounts of magnesium and silver were extracted and preconcentrated by used cloud point extraction (CPE) method in the first step and the determination was the second step by flame atomic absorption spectrometry (FAAS), at pH 10 with used to Triton X-114 as a non-ionic surfactant, a complexing agent used (MPBIM) to the determination of silver and magnesium in many urines, water samples, and other blood serum samples.[12]

For the measurement of a trace metal ion in various matrices, Triton X-100 was employed as the extractor in the CPE technique, which was used for separation and preconcentration. CPE is one of the "green chemistry" principles that include rushing in the time, low cost and higher preconcentration factors. The advantages process of micelle formation is divided when it is heated to a sufficient temperature as the original solution splits into two phases. [13]. Pre-concentration and extraction of Mg^{2+} ions are done by applying the CPE, this method used 2,4-dimethyl-pentane-3-one as extraction species. The creation of solvated species between the metal ion and organic solvent was done to realize the solvated species extraction to the cloud point layer and the maximum absorbance for the ethanolic solution that was 249 nm. This method needs to use different salts out to provide the extraction efficiency i.e., 0.5M from KNO_3 that gives higher extraction efficiency, and variable concentration of other nitrate salts that have been studied too.[14]

Sodium dodecyl sulphate (SDS) was a micelle medium for the determination of magnesium after complexation with 8-hydroxyquinoline. In this study, the maximum absorbance of the complex was 390 nm. critical parameters, like pH of the solution, affect the concentration of ligand and the accuracy and reproducibility of this method. The method has succeeded and given good accurate values for the determination of magnesium in some drugs and samples of mineral water.[15]. The method depends on the formation of ion-pair complexes that were used for the extraction and separation of two metals, ion Mg (II) and Ca (II), after being combined with EDTA (H_3Y-) to form a complex as (MgHY-) and (CaHY-). The anion transfer of the PCL, after using liquid ion exchanger Cinchonine (CK) and the ion-pair formation of magnesium complex was HCK+; MgHY-. [16]. The enhancement of the extraction efficiency for the Solvation technique has used Acetophenone as an organic agent to separate and determine Zn (II) ion. This technique needs salting-out like $NaNO_3$, for the enhancement of the extraction efficiency in presence of methanol when add to the aqueous solution.[17]

A developed extraction method with the micelle mediated for the formation of the ion association complex by using organic reagent brilliant green in acidic media to form an ion association complex with manganese oxyanion as well as many interferences effects of ions were studied.[18]. Crystal violet was used to form an ion-pair association after forming chloro anions in acidic media used for this purpose HCl; this technique is characterized by a sensitive extraction method and separation chloro anions of Zn (II) ion and Ni (II) ion creating a form of an ion-pair association complex.[19]

Experiment

1. Chemicals and Reagents

Deionized water was utilized to make the solutions in this investigation. All materials Triton X-100 for analysis, Eriochrome Blake-T ACS reagent (indicator grade), Janus green B, $MgCl_2.6H_2O$, and others were purchased from Sigma-Aldrich and Merck. The $MgCl_2.6H_2O$ which was used to prepare other solutions was diluted with filtered water in a volumetric flask to make a standard solution of Mg (II).

2. Apparatus

A double beam UV-visible spectrophotometer a Biochrom (Biochrom Libra 560 made in Cambridge, UK) was employed for studying the absorption spectra of compounds produced, it is fitted with a 1cm glass cell path length.

3. General method

Preparing 10 mL aqueous solution that contains 50 µg Mg^{2+} ion, 1×10^{-3} M 8-Hydroxy quinoline, 0.05 M NaOH, 1×10^{-4} M Janus green B, 0.5 mL Triton X-100 (TX-100), and heating the solutions in an electrical water bath at 85 °C for 20 minutes (min.) to form CPL. Then, separation CPL from aqueous solution, and measuring the absorbance of ion-pair association complex of Mg2+ is achieved at λmax=365 nm vs. blank which is prepared at following the same way without Mg2+ ion, in order to determine Mg2+ ion residual in the aqueous solution. After extraction by following Eriochrome Blake-T spectrophotometric method,[20] then determine transfers Mg^{2+} ion to CPL as complex and calculate distribution ratio D by using a calibration curve as shown in Figure (1). All the absorbance values of the cloud point layer or the values which distribute ratios D were calculated, and are considered the result of reading three values for each sample that was checked.

Aluminizing – chromizing diffusion coatings are widely used for high-temperature oxidation and hot corrosion protection of turbine blades used in engine hot sections [2]. The pack cementation method is used for the position of protective coatings on the protection against oxidation, corrosion, and damage [4]. At high temperatures, Al and Cr in the coating are oxidized and form a thin Al2O3 and Cr2O3 scale, which works as the diffusion barrier and reduces the oxidizing speed of the base material. The coated elements are placed in closed or half-closed containers and covered with mixture powder, which consists of metals used for deposition (Al and Cr), the halide activating agent, and inactive filler. The coating is fabricated through the reduction of metal-halide vapors on the surface of the base material followed by diffusion in the solid-state between the introduced metal and the substance [5].

$$D=[Mg^{2+}]_{CPL} / [Mg^{2+}]_{aq} \quad (1)$$

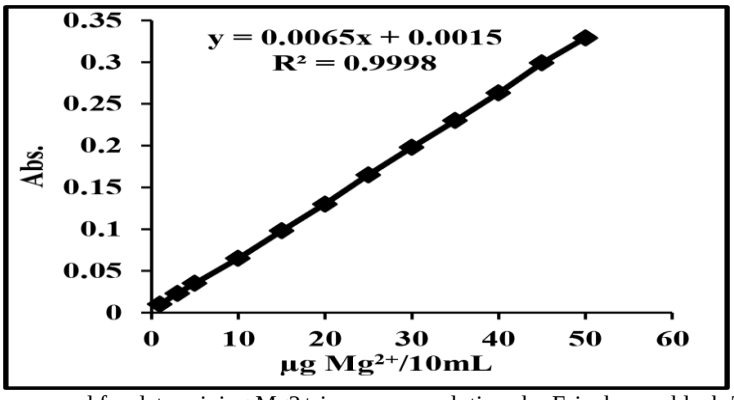

Figure 1Calibration Curve used for determining Mg2+ in aqueous solutions by Eriochrome black-T spectrophotometric method.

Results and Discussion

1. Spectroscopic study

Preparing to 10mL aqueous solution containing 50µgMg^{2+} ion, 1×10^{-3}M 8HQ, 0.3M NaOH, 1×10^{-4}M JGB and 0.5mL Triton X-100 needs heating these solutions in an electrostatic water bath for suitable temperature and time until the formation of CPL. After that, CPL was separated from the aqueous solution and dissolved in 5 mL ethanol, then spectrum for alcoholic Solutions is taken in UV-vis spectrophotometer as illustrated in figure (2).

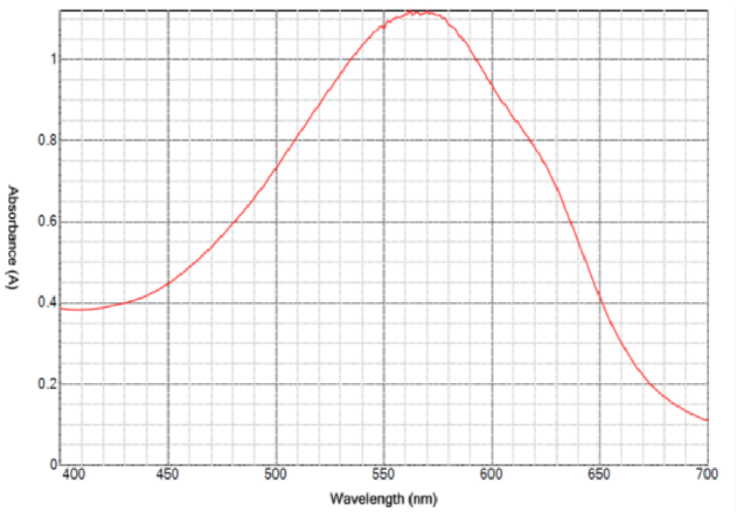

Figure 2 UV-Vis absorption spectrum for ion-pair association Complex

The spectrum clearly shows that the wavelength of maximum absorption for complex extracted was 565 nm.

2. Variation 8-hydroxy quinoline Concentrations

Creating aqueous solutions in 10 mL contains 50 µg of Mg^{2+} ion with different concentrations (Con.) of 8-HQ, 0.3 M NaOH, 1×10^{-4} M JGB and 0.5 mL TX-100, needs heating these solutions in an electrical water bath at 85 °C for 20 min., then, the experiment is completed as shown in the general method illustrated in figure (3).

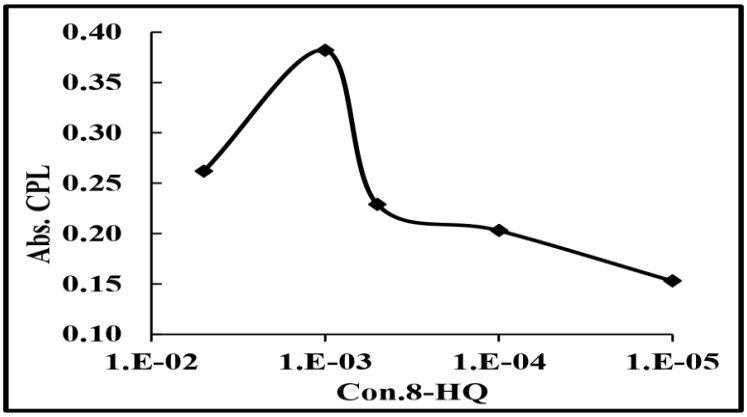

Figure 3 Effect of 8-HQ Con. on the development of the Mg2+ ion complex and its stability.

The Results show up 1×10^{-3}M, 8-HQ was the optimum concentration, in a way that gives higher extraction efficiency, and this concentration has contributed to reaching a higher rate of a thermodynamic relation to form an ion pair association Complex.

3. Variation NaOH Concentration

Preparing a series 10 mL aqueous solutions containing 50 µg Mg ion, 1×10^{-3} M 8-HQ, and different concentrations of NaOH, 1×10^{-4} M JGB and 0.5 mL TX-100, needs heating these solutions in an electrical water bath at 85 °C for 20 min., until the formation of CPL. Afterward, separate the CPL from the aqueous solution, then complete the labor according to the general method illustrated in figure (4) that shows the results.

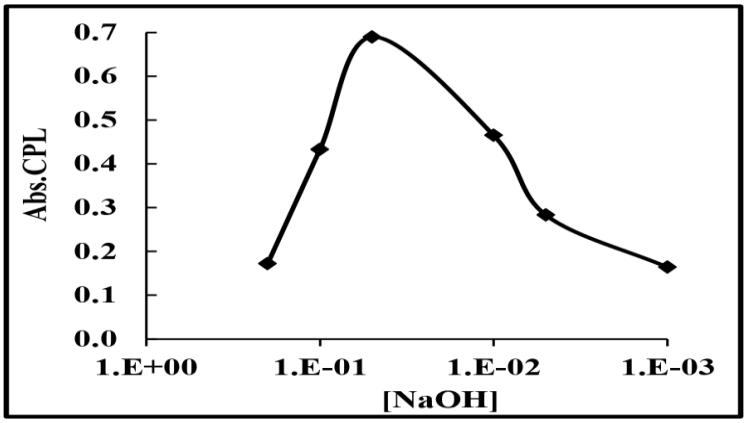

Figure 4 Effect of NaOH Con. on the development of the Mg2+ ion complex and its stability

The results demonstrate 0.05 M which was the optimum concentration of NaOH to give higher extraction efficiency and favorite rate of thermodynamic equilibrium that forms an ion pair association complex. Whereas at this NaOH, concentration produces maximum Con. of oxine (OX^-) to give a higher concentration of anion complex of Mg^{2+}, as well as a higher rate of liquid anion exchange to form a maximum concentration of ion-pair that associates complex extracted into cloud point layer.

4. Variation Mg Ion Concentration

Preparing many 10 mL aqueous solutions contain a rising quantity of Mg^{2+} ion, 1×10^{-3} M 8-HQ, 0.05 M NaOH, 1×10^{-4} M JGB, and 0.5 mL Triton X-100. Then, these solutions are heated in an electrical water bath at 85°C for 20 min. until the

formation of CPL. CPL is then separated from aqueous solutions and the experiment is completed according to the general method illustrated in figure (5) that shows the results.

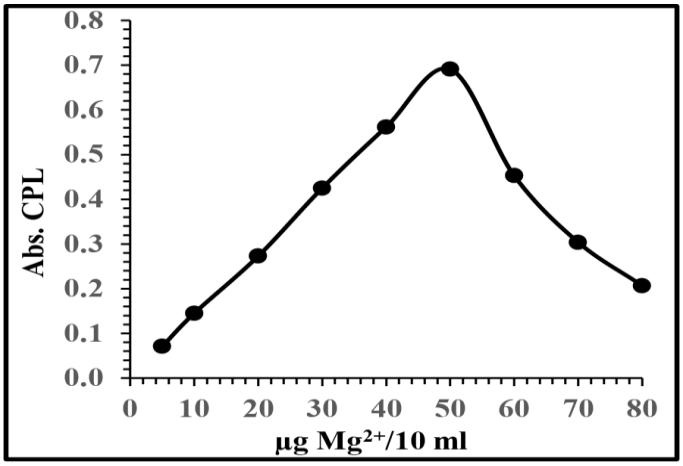

Figure 5 Effect of metal ion Con. on the development of the Mg2+ ion complex and its stability

The results show up an increasing metal ion concentration that gives a straight-line relationship with the increasing concentration of ion-pair association complex formations and D-Value. These results confirm that the metal in concentration is a Thermodynamic Data control thermodynamic equilibrium.

5. Variation JGB concentration

A series of 10 mL aqueous solutions that contain 50 µg Mg^{2+} ion, 1×10^{-3} M 8-HQ, 0.05 M NaOH are prepared with different concentrations of JGB, and 0.5 mL, Triton X-100, needs heating these solutions in an electrical water bath at 85 °C for 20 min. until the formation of CPL. Then, the work is completed according to the general method illustrated in figure (6) which shows the results.

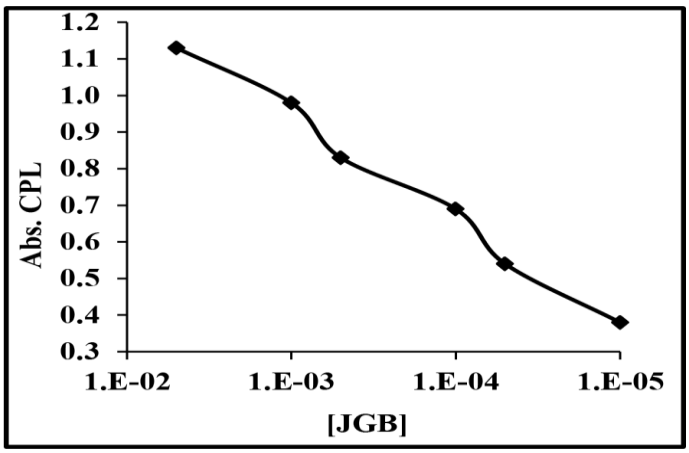

Figure 6 Effect of JGB Conc. on formation and stability for Mg2+ complex extracted

The Results show up an increasing extraction efficiency of Mg^{2+} ion with an increasing organic reagent JGB, which means an increasing JGB effect to increase the velocity of the thermodynamic equilibrium relation for the formation of an ion pair associations complex extracted to CPL. So that, these results confirm with the JGB concentration considered as thermodynamic Data.

6. Variation Surfactant volume

Preparing many 10 mL aqueous solutions containing 50 µg Mg^{2+} ion, 1×10^{-3} M 8-HQ, 0.05 M NaOH, 1×10^{-4} M JGB, with the existence of different volumes of Surfactant TX-100. These solutions are heated in the electrical water bath at 85°C for 20 min. until the formation of CPL. Then, this layer is separated and the work is completed according to the general method illustrated in figure (7) that shows the results.

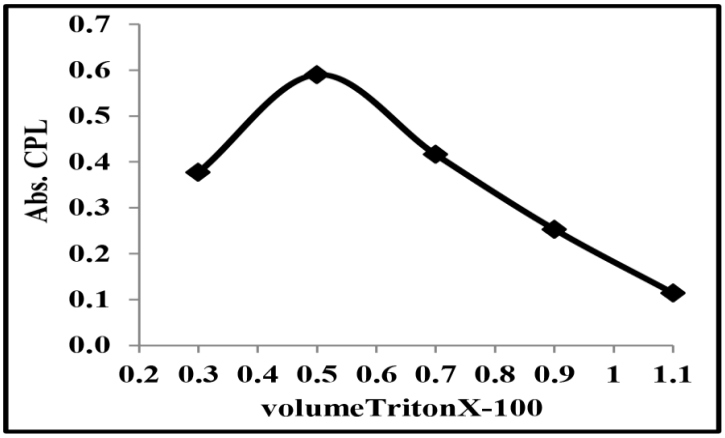

Figure 7 Effect of Triton X-100 volume on the Quality of CPL

The Results illustrated 0.5 mL of TX-100 which was the optimum volume of surfactant to form a high quality of CPL, which gives a higher extraction efficiency of ion pair association complex for Mg^{2+} ion with JGB and 8-HQ.

7. Variation Effect of Temperature

A series of 10 mL aqueous solutions contain 50 µg Mg^{2+} ion, 1×10^{-3} M 8-HQ, 0.05 M NaOH, 1×10^{-4} M JGB, 0.5 ml Triton X-100. These solutions are heated in an electrical water bath at different temperatures for a suitable time until the formation of CPL. Then these layers are separated and the work is completed according to the general method illustrated in figure (8) that shows the results.

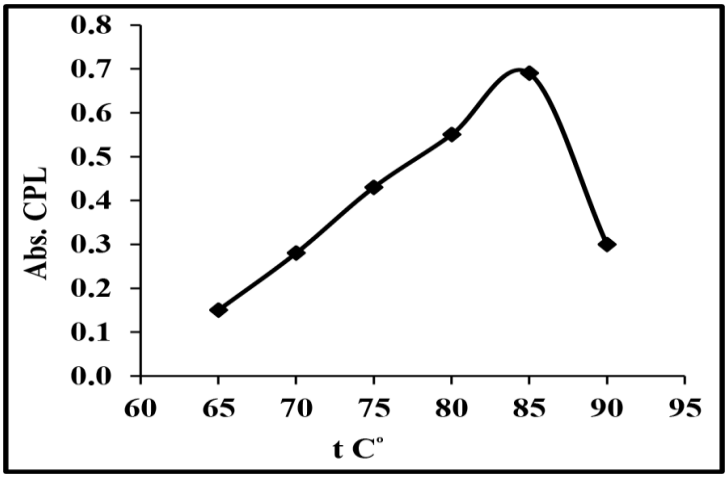

Figure 8 Effect of temperature on CPL development Quality

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The results show that 85°C was the optimum temperature that gives excellent quality for CPL and gives higher extraction efficiency. Afterward, one should calculate the extraction constant K_{ex} from D-values. Figure (9) shows the results.

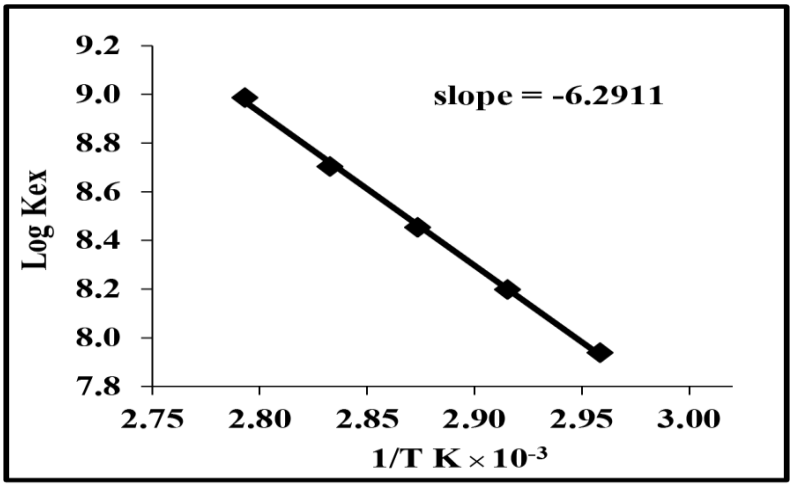

Figure 9 Effect of Temperature on extraction Constant of Mg2+ ion as ion pair association complex

Then from slope value of straight-line relations in Figure (9), and the Thermodynamic relation determined the thermodynamic Data of extraction Mg according to the compact method.

$$\Delta Hex = 0.1205 \ kJ.mol^{-1}$$

$$\Delta Gex = -61.36 \ kJ.mol^{-1}$$

$$\Delta Sex = 171.74 \ J.mol^{-1} k^{-1}$$

8. Effect of Heating Time

Preparing 10 mL aqueous solutions contain 50 µg Mg^{2+} ion, 1×10^{-3} M 8-HQ, 0.05 M NaOH, 1×10^{-4} M JGB, 0.5 mL Triton X-100. This solution is heated in an electrostatic water bath at 85 °C for different times until the formation of CPL. Then, these CPL are separated and the following compact method is completed according to the general method illustrated in figure (10) that shows the results.

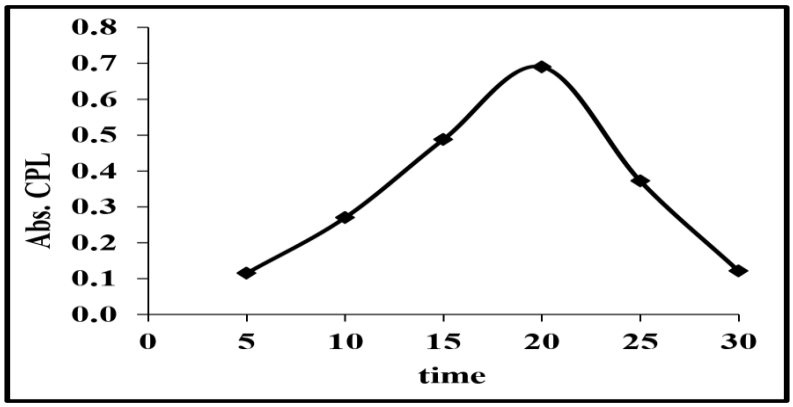

Figure 10 Effect of Temperature on extraction Constant of Mg2+ ion as ion pair association complex

The results appear within 20 minutes, which is the optimum time suitable for the formation of the best CPL. These results are in increased extraction efficiency because this CPL ability is capable of extracting a greater quantity of the Mg^{2+} ions after the formation of an ion pair association complex.

Stoichiometry

In order to see the composition of Mg^{2+} ion pair, an association complex was extracted to form CPL. The first method to be followed was the Slope analysis while the second one was the Slope ratio method, i.e., by the application of a compact method as detailed in the general method.

1. Slope analysis

The results of the Slope analysis method were as in Figure (11).

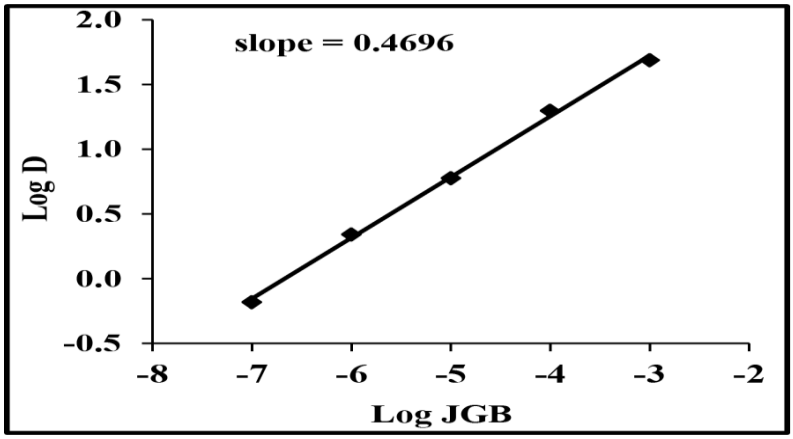

Figure 11 Slope analysis method.

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The results of the slope analysis confirm the structure of the ion pain association complex which was 1:1 JGB^{+}:$Mg(OX)_3^{-}$

2. Slope Ratio

The Slope ratio method was applied by a Compact method, and the results were illustrated in figure (12-13).

The results in the slope ratio method show that the Slope ratio value is equal to (566.01 /560.20 = 1.01), this confirms the structure of ion pain association complex was 1:1 JGB^{+}:$Mg(OX)_3^{-}$.

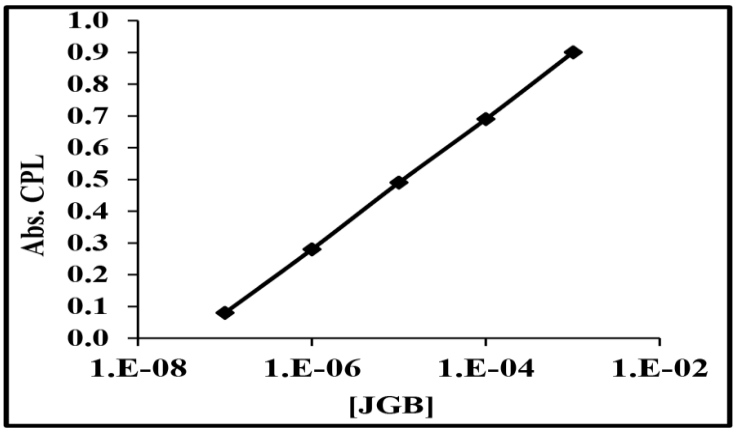

Figure 12 Effect of JGB Con. On development and stability of ion pair association Complex of Mg2+ ion.

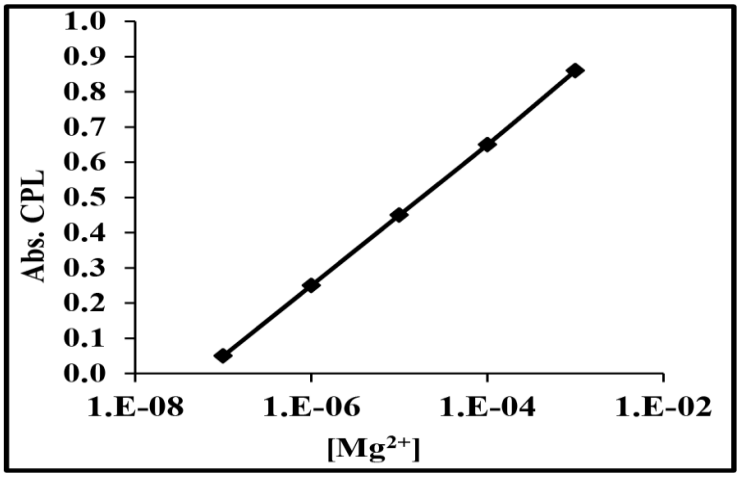

Figure 13 Effect of Mg2+ ion Con. on formation and stability of ion pair association Complex of Mg2+ ion.

Electrolyte effect

Through an application of the Compact method which is detailed in the general method that extracted Mg^{2+} ion at optimum conditions in existence different electrolyte salts in aqueous solution at 0.01 M Con., Table (1) shows the results.

Table (1): Effect of Electrolytes on Extraction Efficiency of Mg2+ ion

Electrolyte	Abs. CPL 565 nm	D
NaCl	0,883	33.21
KCl	0.812	29,95
NH_4Cl	0.754	23,07
$AlCl_3.6H_2O$	0.796	25.00

The results demonstrate the existence of electrolyte in aqueous solution side by side with Mg^{2+}ion effect to increase the extraction efficiency, that is the purpose of electrolyte salt effect is to increase the formation of an ion-pair association complex extracted to CPL, as well as the effect to increase dehydration to increase the quality of cloud point layer formations.

Interferences

Preparing 10mL aqueous solutions to contain 50 µg Mg^{2+} ion, 1×10^{-3} M 8-HQ, 0.05 M NaOH, 1×10^{-4} M JGB, 0.5 mL Triton X-100, with existence 0.01M some metal ions, needs heating these solutions at 85°C for 20 minutes in an electrostatic water bath to form CPL. Then the work is completed according to the general method illustrated in the table (2) which shows the results.

Table (2): Effect of interferences on Extraction Efficiency of Mg^{2+} ion

interferences	Abs. CPL 565 nm	D
Zn^{2+}	0.5l0	11.26
Ca^{2+}	0.493	8.70
Ba^{2+}	0.362	5.57

The results show up the existence of foreign ion in aqueous solution side by side with Mg^{2+} ion which can develop ion pair-association complex with organic reagent JGB ad 8-HQ effect to decrease the extraction efficiency of Mg^{2+} ion due to the consumption of some 8HQ and JGB. Besides, their concentrations are declined less than the optimum concentration necessary for the extraction of Mg^{2+}ion with high efficiency.

Effect of Organic Reagent kind

Preparing three aqueous solutions 10mL in the volume containing 50 µg Mg^{2+} ion, 1×10^{-3} M 8-HQ, 0.05 M NaOH, 0.5 mL Triton X-100 and 1×10^{-3} M of different organic Reagent. Then, these solutions are heated in an electrostatic water bath at 85°C for 20 mint. until the formation of the CPL complex. the work is done according to the general method illustrated in table (3) which shows the results.

Table (3): Effect of Organic Reagent Kind.

Organic reagent	λmax	Abs. CPL	D
Safranin	535	0.520	14.12
Crystal Violet	513	0.601	16.52
Rhodamine 6G	539	0.492	10.02

The results show that there is a different extraction efficiency with different organic reagents because there is a different ability to form an ion-pair association complex with Mg $(OX)_3^-$, that functions as an ion exchange due to the structure of the organic reagent and its behavior in aqueous solution.

Conclusion

1. It is necessary to adjust the alkaline medium to form Oxine.
2. It is very important to specify 8-Hydroxy quinoline concentrations used in aqueous solution to form the magnesium anion complex $Mg(OX)_3^-$, thermodynamically.

3. A suitable concentration of organic reagent must be used to get an excellent rate of formation direction of ion pair association complex in thermodynamic equilibrium.
4. By using LiCl as a strong electrolyte salt in an aqueous solution, enhancement should be given in the extraction efficiency of Mg^{2+}ion, because any increase will destroy hydration of Mg ion and lead to the dehydration of micelles became its smaller ionic Radius.
5. The heating time represents the kinetic site of the extraction method which has given sufficient time for the dehydration and formation of an ion pair complex, as well as the partition of an ion pair complex to the Cloud port layer.

Recommendation

1. It is possible to use this Compact method for the separation and determination of other metal ions in aqueous solutions.
2. It is possible to use EDTA as an ion instead of 8HQ to form an ion pair association complex.
3. For the separation and determination transition or lanthanide and Actinide of metal ions, high molecular amines or azo-derivative, Crown ether and Cryptands must be used in Acidic HCl medium.
4. In order to determine Mg^{2+} ion in aqueous solution samples, a suitable masking agent must be used for other metal ions existence in aqueous solutions.
5. When Crown ether and Cryptand are used to separate and determine a metal ion as an ion by liquid ion-exchange it is possible to apply this method from acidic, alkaline and Neutral media.

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All-Optical Universal Logic Gates at Nano-scale Dimensions

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Nanophotonics;
All-optical devices;
Universal Logic Gates;
Plasmonic Technology.

Abstract

Though photonics displays an attractive solution to the speed limit of electronics, decreasing the size of photonic devices is one of the major problems with implementing photonic integrated circuits that are regarded as the challenges to produce all-optical computers. Plasmonic can solve these problems, it is a potential solution to fill the gaps in the electronics (large bandwidth and ultra-high-speed) and photonics (diffraction limit due to miniaturization size). In this paper, Nano-rings Insulator-Metal-Insulator (IMI) plasmonic waveguides have been used to propose, design, simulate, and perform all-optical universal logic gates (NOR and NAND gates). By using the Finite Element Method (FEM), the structure of the proposed plasmonic universal logic gates are designed and numerically simulated by two dimensions (2-D) structure. Silver and Glass materials were chosen to construct the proposed structure. The function of the proposed plasmonic NOR and NAND logic gates was achieved by the destructive and constructive interferences principle. The performance of the proposed device is measured by three criteria; transmission, extension ratio, and modulation depth. Numerical simulations show that a transmission threshold (0.3) that allows achieving the proposed plasmonic universal logic gates in one structure at 1550 nm operating wavelength. The properties of this device were as follows: The transmission exceeds 100% in one state of NAND gate, medium values of Extension Ratio, very high MD values, and very small footprint. In the future, this device will be the access to the nanophotonic integrated circuits and it has regarded fundamental building block for all-optical computers.

Introduction

In the rapidly improving photoelectric technology process, using optical waveguides to transmit and receive a signal is one of the best ways to increase the internet bandwidth (capacity) and speed. The confinement process of relatively high optical intensity in a small guiding space (ranging about a few tens of nanometers) is achieved by waveguide structures. Much of the recently published scientific research has paved the way for the use of this technique (optical waveguides) in many applications, especially in optical communications systems and in photonic integrated circuits. Utilizing optical devices in these two applications has many advantages like higher communication bandwidth and higher transmission speed in optical communications systems and nanometer-scale size, high capacity, ultrahigh-speed information processing, security to electromagnetic interference, low power consumption, and overcoming the diffraction limit in photonic integrated circuits. Sub-wavelength devices mean plasmonic devices. The study of plasmonics is a brunch of Optoelectronics/Nanophonics Engineering. In recent years, all-optical logic devices based on plasmonic technology have been the topic of comprehensive research. Plasmonic technology is a new technique that overcomes the obstacles in electronic devices performance limitations, which suffer from high heat generation and ingrained delay, as well as to overcome the diffraction limit that is the major obstacle in photonics devices. Thus, using plasmonic devices enabled manipulating light on a sub-wavelength scale; that is the reason why named the plasmonic is a subwavelength [1]. The process of interaction of electromagnetic waves with the free electrons in metals is called Surface Plasmon Polaritons (SPPs). SPPs are propagating on the metal-dielectric interface [2-3]. It is a collective wave where billions of electrons oscillate in synchronization at optical frequencies. Plasmons can travel along nanoscale wires. Recently, many structures that perform plasmonic technology proposed universal logic gates [4-8]. Each structure has a different way to realize the function of the universal gates, different geometries, different materials of the structure, different numbers of universal logic gates, different types of universal logic gates, different values of resonance wavelength, and different values of transmission.

This paper offers the smallest structure from other structures that perform plasmonic universal logic gates and in the same structure. The materials, structure parameters, resonance wavelength, and transmission threshold in both structures are the same. The structure is constructed with a Nano-rings resonator and Insulator-Metal-Insulator (IMI) plasmonic Nano-waveguides. The plasmonic universal logic gates proposed, designed, simulated, and realized are NOR and NAND. The simulation results obtained by COMSOL Multiphysics package software (version 5.3a) are based on the Finite Element Method (FEM). In the future, this device will be the access to the nanophotonic integrated circuits, and it has regarded fundamental building block for all-optical computers.

Theoretical Concepts

Plasmonic waveguides are used to guide the SPPs signal between dielectric-metal interfaces. Two types of waveguides are mostly used in plasmonic structures recently: insulator-metal-insulator (IMI) plasmonic waveguides and metal-insulator-metal (MIM) plasmonic waveguides. Because IMI waveguides have more propagation length, less propagation loss, and are easier in fabrication [9]. Therefore, we chose IMI plasmonic waveguides rather than MIM plasmonic waveguides due to their benefits.

Our suggested design consists of two nano-rings resonators and three straight stripes to construct, which is based on an insulator metal-insulator (IMI) as shown in Figure 1 with parameters shown in Table 1. The proposed design is made of

two materials, the first is silver, which is a metal, the straight stripes and the nano-rings resonator are made of it and the second material is Glass with a refractive index equal to 1.52 that forms the remainder of this structure. The Silver permittivity is characterized by Johnson and Christy data [10].

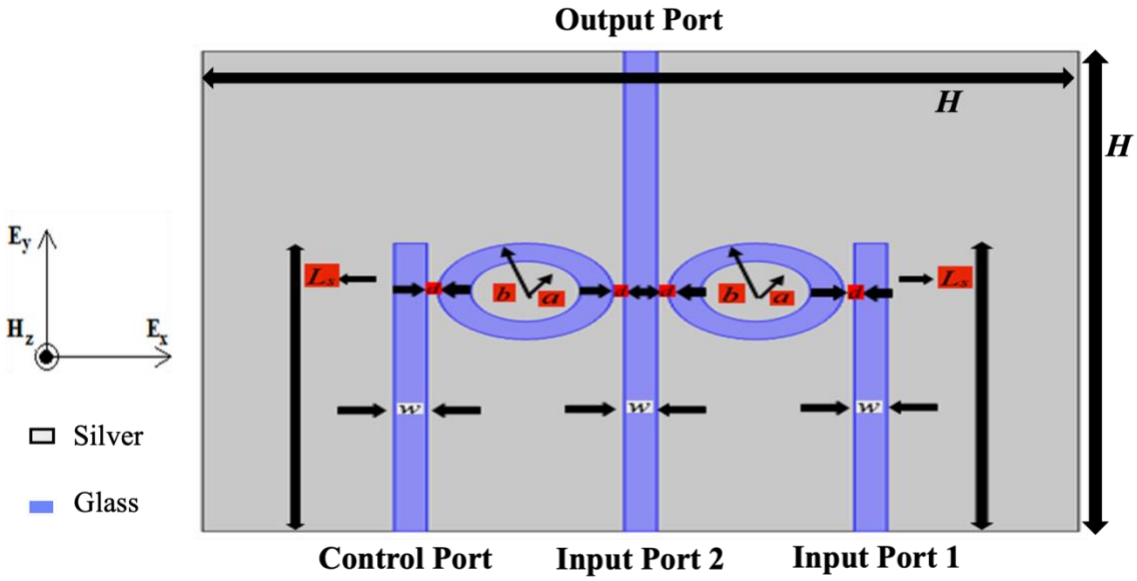


Figure 1 Plasmonic universal logic gates structure

Table 1. Structure parameters of the proposed design

Parameter	Description	Value
d	Distance between stripes and nano-rings	5 nm
w	Stripes width	15 nm
a	The smaller radius of nano-ring	25 nm
b	The bigger radius of nano-ring	40 nm
L_s	Length of the middle stipe	240 nm
H	Width and Length of the structure	400 nm

The operating wavelength is 1550 nm was chosen because it is the optimum wavelength in optical telecommunication systems. The type of interference when the two inputs and the control signal have the same phase is constructive interference. Otherwise, if the phase of the light wave of the inputs and control signal are different, destructive interference will happen. We conclude the phase difference causes a destructive interference between the waves [11].

Two-dimensional (2-D) structure in COMSOL Multiphysics software (version 5.3a) based on the FEM method is used to solve Maxwell equations. A plane wave with Transverse Magnetic (TM)-polarized that has Ex, Ey, and Hz electromagnetic field components are exposed to the proposed structure.

Four ports for the proposed structure, these ports as follows: two input ports, an output port, and a control port. According to the optimum results for the plasmonic universal logic gates, these ports are assigned. SPPs are excited when the input port(s) and control port are launched by a plane wave with TM-polarized. The performance of the proposed device is measured by three criteria: the first is the borderline between Logic 0 and Logic 1 at the output that is called transmission, the transmission is defined by Equation 1 [12-13]. Logic 0 and logic 1 are separated by 0.3, which is the transmission threshold value. The second is the extension or contrast ratio. This criterion is described by Equation 2 [12]. The third is modulation depth (MD), MD is defined by Equation 3 [14-15].

$$T = \textit{Output optical Power / Input Optical Power} \tag{1}$$

Where T is the transmission.

$$\textit{Extension Ratio (dB)} = 10 \log \left(\frac{P_{out}|ON}{P_{out}|OFF}\right) \tag{2}$$

Where: $P_{out}|ON$ is the minimum output power in ON state and $P_{out}|OFF$ is the maximum output power in the OFF state.

$$\textit{Modulation Depth (MD)} = \left(\frac{T_{ON}|Max - T_{OFF}|Min}{T_{ON}|Max}\right) \times 100\% \tag{3}$$

Where: $T_{ON}|Max$ is the maximum transmission in ON state and $T_{OFF}|Min$ is the minimum transmission in the OFF state.

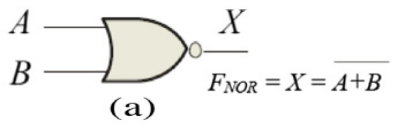
Simulation Results and Discussion

The performance of all-optical NOR and NAND logic gates by discussing the simulation results will be presented in this section. The proposed structure is exposed by a light wave with (800 nm - 2000 nm) wavelength range. This band is used because it is the most useful band in optical communication. The illumination of light is launched to the control port and the input port(s) (ON state). The function of each proposed plasmonic gate is achieved by two factors:

The right choice for assigning structure ports. The right choice of the phase angle, which makes the destructive and constructive interferences between light in input ports and the light in the control port.

A. All-Optical NOR Logic Gate

NOR gate is a gate that produces logic 0 at the second, the third, and the fourth states in its truth table, but at the first state produces logic 1. Figure 2(a) and 2(b) show the symbol and truth table of the NOR gate, respectively.



(a)

Inputs		Output
A	B	X
0	0	1
0	1	0
1	0	0
1	1	0

(b)

Figure 2 (a) NOR logic gate symbol, and (b) NOR logic gate truth table

The proposed structure which performs a plasmonic NOR logic gate was shown in Figure 1. NOR gate can be achieved by destructive interference in the second, third, and fourth states. In the first state, the input ports are OFF, but a light to the control port is launched wavelength and phase always equal to 1550 nm and 180°, respectively. The output port is ON in this state, the transmission is 0.3265 that is above the threshold value. In the second state, the phase of the input light to input port 2 is 45°. The output port is OFF; the transmission in this state is 0.0723 that is below the threshold value. In the third state, the phase of the input light to input port 1 is 45°. The output port is OFF, the transmission in this state is 0.0025 that is below the threshold value. In the fourth state, the phase of the input light to the input ports (1 and 2) is 45° and 0°, respectively. The output port is OFF in this, the transmission is 0.071 that is below the threshold value. Due to the phase difference, destructive interference occurred in the last three states between the input signal(s) and the control signal. The curve of transmission with wavelength range for the plasmonic NOR logic gate is shown in Figure 3. The validation of the proposed plasmonic NOR logic gate is explained in Table 2.

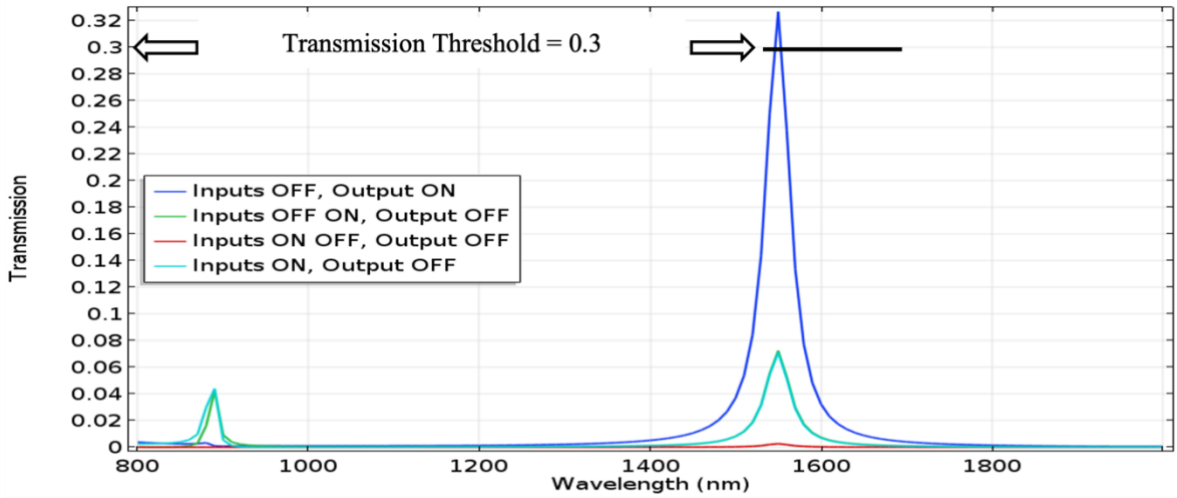


Figure 3 The transmission curve Vs. the wavelength range for NOR logic gate

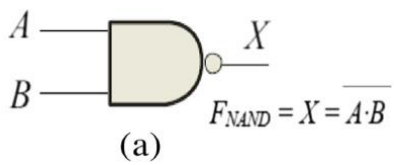
Table 2. Validation of the proposed plasmonic NOR logic gate

State 1	State 2	In 1 (Phase)	In 2 (Phase)	Control (Phase)	*T*	$T_{thresh.}$	Output	Output Port
0	0	OFF(0°)	OFF(0°)	ON(180°)	0.3265	0.3	1	ON
0	1	OFF(0°)	ON(45°)	ON(180°)	0.0723		0	OFF
1	0	ON(45°)	OFF(0°)	ON(180°)	0.0025		0	OFF
1	1	ON(45°)	ON(0°)	ON(180°)	0.071		0	OFF

According to Equation 2, the value of extension ratio of the plasmonic NOR gate is 6.55 dB that is regarded as medium value and the performance of this gate is moderate according to [12]. While the value of MD is 99.2% (According to Equation 3) that is regarded very high value and the dimensions of the proposed structure is excellent and optimum.

B. All-Optical NAND Logic Gate

NAND gate is a gate that produces logic 1 at the first, the second, and the third states in its truth table, but at the fourth state produce logic 0. Figure 4(a) and 4 (b) show the symbol and truth table of the NAND gate, respectively.



(a)

Inputs		Output
A	*B*	*X*
0	0	1
0	1	1
1	0	1
1	1	0

(b)

Figure 4 (a) NAND logic gate symbol, and (b) NAND logic gate truth table

The proposed structure, which performs a plasmonic NAND logic gate, is shown in Figure 1. NAND gate can be achieved by constructive interference in the second and third states and by destructive interference in the fourth state. The input ports are OFF in the first state, but a light to the control port is launched wavelength and phase always equal to 1550 nm and 0°, respectively. The output port is ON in this state, the transmission is 0.3265 that is above the threshold value. In the second state, the phase of the input light to input port 2 is 0°. The output port is ON, the transmission in this state is 0.77 that is above the threshold value. In the third state, the phase of the input light to input port 1 is 0°. The output port is ON in this

state, the transmission is 1.306 that is above the threshold value. In the fourth state, the phase of the input light to the input ports (1 and 2) is 180° and 90°, respectively. The output port is OFF in this state, the transmission 0.0425 that is below the threshold value. The curve of transmission with wavelength range for plasmonic NAND logic gate is shown in Figure 5. The validation of the proposed plasmonic NAND logic gate is explained in Table 3.

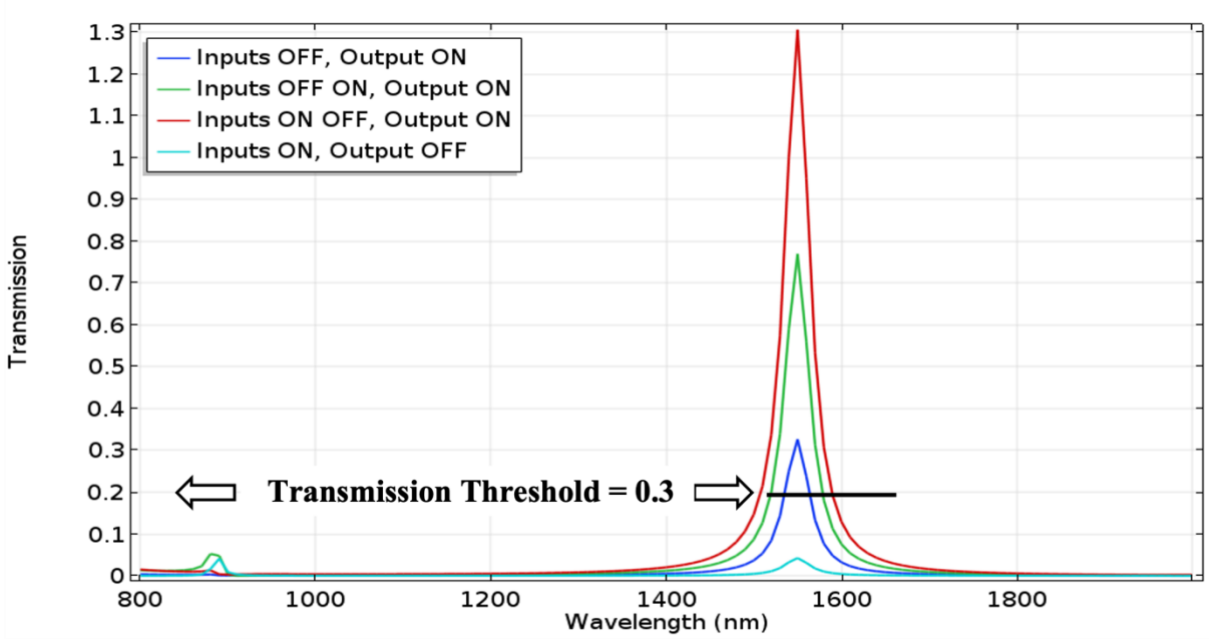


Figure 5 The transmission curve Vs. wavelength range for NAND logic gate

Table 3. Validation of the proposed plasmonic NAND logic gate

State 1	State 2	In 1 (Phase)	In 2 (Phase)	Control (Phase)	*T*	$T_{thresh.}$	Output	Output Port
0	0	OFF(0°)	OFF(0°)	ON(0°)	0.3265	0.3	1	ON
0	1	OFF(0°)	ON(0°)	ON(0°)	0.77		1	ON
1	0	ON(0°)	OFF(0°)	ON(0°)	1.306		1	ON
1	1	ON(180°)	ON(90°)	ON(0°)	0.0425		0	OFF

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According to Equation 2, the value of extension ratio of the plasmonic NAND gate is 8.85 dB that is regarded as a medium value and the performance of this gate is Good and efficient according to [12]. While the value of MD is 96.75% (According to Equation 3) that is regarded very high value and the dimensions of the proposed structure are excellent and optimum.

Comparison with Previous Works

Plasmonic universal logic gates in this work are compared with the other previous papers as shown in Table 4.

Table 4. Comparison between this paper and the other previous papers.

Criteria / Paper	This Paper	Reference [4]	Reference [5]	Reference [6]	Reference [7]	Reference [8]
Topology	IMI Waveguide	Plasmonics Kerr effect based Mach-Zehnder interferometer (MZI)	MIM Waveguide	MIM Waveguide	MIM Waveguide	MIM Waveguide
Dielectric / Metal Used	Glass / Silver	Non-Linear Kerr Material	Air / Silver	Air / Silver	Non-Linear Kerr Material	Non-Linear Kerr Material
Permittivity Metal Description	Johnson Data	--------	Drude Model	--------	--------	Drude Lorentze model
Number of Proposed Universal Logic Gates	Two Gates	Two Gates	One Gate	One Gate	One Gate	One Gate
Type of Universal Gates	NOR and NAND	NOR and NAND	NOR	NAND	NAND	NAND
Size	400 nm × 400 nm	45 um × 8 um	More than 3 um × 2 um	40 um × 7.5 um	40 um × 7.5 um	36 um × 8 um
Performance Measured	Transmission, Extension Ratio, and MD	Extension Ratio and Insertion Loss	Transmission and Extension Ratio	Insertion Loss and Extension Ratio	Extension Ratio and Insertion Loss	Extension Ratio and Insertion Loss
Maximum Transmission %	130% at NAND Gate	--------	80.07 at NOR Gate	--------	--------	--------
Amplifying of Transmission	Exists in NAND Gate	--------	Does Not Exist	--------	--------	--------
Complexity in Fabrication	Less complexity	More Complexity	More Complicated	More Complicated	More Complexity	More Complexity

Conclusion

In this paper, plasmonic universal logic gates in a new configuration, which is based on nano-rings IMI plasmonic waveguides, were proposed, designed, and demonstrated. The borderline between state 1 and state 0 at the output is 0.3. By destructive and constructive interferences, which happen between the control signal and input signal(s), the function of the proposed plasmonic universal logic gates is realized. The proposed plasmonic universal logic gates can be achieved by the right choice for assigning the ports in the proposed structures (which is an input port(s), which is a control port, and which is an output port), and the right choice of phase angle which make the destructive and constructive interferences. The performance of the proposed structure is measured by three parameters; Transmission, Extension Ratio, and Modulation Depth (MD). The minimization or maximization of the transmission at the output port can be controlled by; structure shape, structure size, structure parameters, materials used in the structure, refractive index of the selected materials, the position of the ports in the structure, and its phase. In accordance with the size, shape, parameters, and materials of structure, the SPP is excited at a 1550 nm wavelength. The properties of this device were as follows: The transmission exceeds 100% in one state of NAND gate, medium values of Extension Ratio, very high MD values, very small area, and operating wavelength is 1550 nm. In the future, this device will be the access to the nanophotonic integrated circuits and it has regarded fundamental building block for all-optical computers.

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Role of Nanoparticles Synthesized from Bacteria as Antimicroorganism: A Review

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Keywords:
Nanoparticles Synthesis;
Bacteria;
Antimicroorganism.

Abstract

Nanoparticles are one of the most important technologies of today and the future. This groundbreaking technology is considered a very significant domain among all the fields of science due to its tangible capacity in improving products, treating diseases, serving mankind in all spheres of life, and realizing future scientific revolutions in the fields of physics, chemistry, biology, engineering, and other sciences. Therefore, it is truly necessary to take advantage of the distinct properties of nanomaterials. Hence, synthesized nanoparticles have been shown to be enjoying anti-proliferating antioxidant, anti-migration, antioagulant and anti-cancer antipathogenic characteristics in the laboratory. Accordingly, this study came to prominence in this field. The biochemical equipment used in nanoparticle bacterial biosynthesis was subsequently proven. Many of these biochemical types of equipment have been used as part of a cellular detoxification resistance mechanism that involves altering inorganic ions solubility by reducing and/or precipitating soluble toxic to insoluble non-toxic nanostructures. Microorganisms, such as bacteria, are used as an environmentally responsible strategy, and an alternative in the method of chemical agents when nanoparticles are synthesized. Extracellular as well as intracellular biocatalytic (including possible excretion) synthesis involves mainly oxidreductase enzymes like NADH dependent reductase nitrate NADPH, NADPH sulphite reductase alfa (NADPH dependent on sulfite reductase) and cells.

Introduction

The prefix (nano) was derivative of the Greek term 'Nanos,' which significance (dwarf). 1 nm is 1 milliard from a M or 6 carbon atoms, and ten water molecules in weight. Hominid curls are around eighty thousand nanometers extensive plus RBC i.e., about 7,000 nanometers in width, and with particles of less than 1 nanometer; however, a lot of particles are composed of few proteins that begin from one nm to more [1]. The physical properties that belong to metal particles in the nanometer size range were altered as of ions and neutral majority substance. It has been shown that notable things like bigger catalytic action are owing to highly active morphologies. In restoring toxic metals by reducing metal ions, microorganisms such as bacteria and fungus are now important [2]. Bifidobacterium bifidum is isolated as a marketable TiO2 tablet and is capable of using various methods to analyze anti-microbial action counter to stool-isolated bacteria of patients with acute diarrhea [3].

In the last few years, interest in the production metallic in nature materials has increased. Nanoparticles are used in a variety of fields, such as medical, biological, agricultural, environmental and industrial fields. The importance of nanomaterials has primarily arisen because their high surface ratio is related to their size i.e., smallness; this feature increases its contact surface with other bodies [4]. Different techniques have been used to determine the inhibiting zone of microorganism after being treated with nanoparticles. The techniques depend on determining the inhibiting region according to disc diffusion test and minimum inhibitory concentration MIC and through using macrodiluting as well as microdiluting test, in addition to minimum bactericidal concentration MBC. Finally, the period of killing and inhibiting zone is important in diffusion tests which are generally favored. There are also some differences among M I C and M B C which are informal despite the difficulties that combine the application which is related to the volume of bacteria dose [5].

Nanoparticles Production Approaches

1 - Extra cell and experiment bacteria were cultivated in a proper medium then protected at 150 rpm in an orbital shaker at 37°C.

Bouquet was centrifuged following incubation; the supernatant was employed for nanoparticles production then it was added to individual response containers which contain the ion. Besides, nanoparticles were incubated at appropriate concentrations in seventy-two hours. Dye changes in the response mix suggest the occurrence of nanoelements and bio reduction by using a UV visible spectrophotometer. The dye alterations at response mix suggest the occurrence of nanoparticles and bio reduction by means of a UV visible spectrophotometer which is monitored in the solution by collecting evaluating the absorbance spectra in an aqueous solution Silver's morphology and consistency of 3 distinct bacterial groups biological synthesis a collection of nanoparticles 68 nanoparticles are studied by X-ray (XRD) and scanning electron microscope (SEM) (SEM) diffracting, and by Fourier infrared spectroscopy, The interaction of protein and AgNP is investigated. (FTIR) [6].

2 – The Intra cell Method.

The crop was growing in an appropriate fluid medium that is incubated at optimal heat with a shaker. Once the flask is incubated, the biomass remains static so that the surfactant is discharged and then sterilized. Besides, disinfected water was supplemented to wash the cells. Containers are maintained for thirty minutes to fix the biomass after being discarded from the surfactant. This procedure must be recurrent three times. After that, the biomass is processed. centrifuged for 10 minutes

by using sterile distilled water. The biomass is then centrifuged from sterilized distilled water for ten minutes. The misty biomass was visible to fifty ml of aqueous filtered metal solution at different dilutions and incubated at the correct temperature until changes in visual color appear. Color changes from pale yellow to brownish show that silver nanoparticles have been produced, with the color shift from pale yellow toward pink, as well as the production of golden nanoparticles, yellow shows the production of manganese and zinc nanoparticles [7]. Extra-cell nanoparticles contain catching and reducing the metal ions in cells on the surface, with the existence of enzymes, whereas ions are transmitted into the microbes' cells during the existence of enzymes into nanoparticles [8]. The biotic nanoparticle synthesis was employed in the treatment of cancer, DNA test, antimicrobial causes, biosensors, and imagery with magnet resonance. [9]

Bacteria that synthesize silver, the first proof of silver nanoparticles synthesizing bacteria, is identified by means of the *Pseudomonas* stutzeri AG259 strain was isolated from the silver mine. Round about microbes are able to live and develop under metal ion concentrations under such conditions, and their resistance to this metal is what makes it possible. Resistance tools contain efflux systems, alterations in solubility and toxicity by reduction or oxidation, biomass absorption, bioaccumulation, the development, or precipitation of extracellular complexes of metals and the absence of exact systems for metal passage [10]. The production of Ag nanoparticles (AgNPs) is achieved by using *Streptococcus pyogenes* [11]. There is also another aspect to which their experience with higher concentrations of metal ions may induce toxicity even if these organisms may grow at lower levels. The most commonly accepted 26 mechanisms of silver biosynthesis are the presence of the enzyme nitrate reductase. The nitrate is converted into nitrite by the enzyme. In in vitro synthesis of silver by bacteria, a Nicotinamide adenine dinucleotide phosphate-dependent nitrate reductase would delete the downstream processing phase needed in other cases by alpha-nicotinamide adenine dinucleotide phosphate reduced form. Nitrate is transformed into nitrite during reduction and the electron transfers to a silver ion, thus the silver ion (Ag+ to Ag0) is reduced to silver. This was reported in Bacillus licheniformis known for secreting nicotinamide adenine dinucleotide phosphate and NADPH-dependent enzymes such as nitrate reductase which changes Ag+ into Ag0 [12]. The appliance is additional definite with the use of Fusarium *Oxysporum*. Silver Nitrate purified nitrate reductase along with NADPH in test tubes and color, in the reaction mixture, is altered into brown. Further analysis has confirmed that silver nanoparticles are available [13]. Cases have also shown that silver nanoparticles without the presence of enzymes are different to biosynthesize. It has been found that the interaction of 27 of the silver ions with groups on the microbial cell wall has dried Lactobacillus sp. A09 cells can reduce silver ions [14].

The management of infective illnesses had developed an important test for the health program as several micro-organisms which are resistant to unoriginal antibiotics have increased. Progress in nanotechnology has had a strong impact on human health on metallic NPs, with broad antimicrobial functionality. The physicochemical properties and biological activities of nanoparticles (NPs) range in dimensions between 10 and 1000nm. Nanoparticles synthesized in microbial metals and metal oxides usage many appliances to destroy and/or prevent the growing microorganisms that cause disease, as a result, antimicrobials appear to be a viable option to develop the cure [15]. These NPs are stable in long-term storage and can tolerate severe processing requirements that contain high temperatures and pH without being inactive [16].

Nanoparticles form and mass affect the antibacterial action of nanoparticles. Units of 1 to 10 nm in size have shown a greater activity than their bigger counterparts in bactericide. Thus, in the biomedical field, small dimensions are widely used with improved biocompatibility [17]. In addition, NP works on a variety of microbial goals to apply its antibacterial methods. The cellular membrane should be directly interrupted or the cellular components might be indirectly damaged by

free radicals, and this may harm the DNA, protein and other cell components and inhibit them from synthesizing. A cost-effective and non-toxic nanoantimicrobial agent is good causes for using this method. In Iraq, biosynthesized ZnO NPs with antibiotic activity have been shown to have antibacterial and antibiofilm activities combined and covered with medical materials against multi-drug resistive bacteria. In biomedical, pharmaceutical, and other applications, these nanoparticles may also be used as efficacy [18]. Biosynthesis of Streptococcus pyogenic silver nanoparticles is done at various concentrations (20, 40, 6080 and100), µg/ml by agar well-diffused assay, and antifungal activity Candida species with environmental Pseudomonas sp. and Enterobacter extracts, respectively [19].

The antibacterial effect of ZnO NPs generated by a simple and low-cost approach (sol-gel method) against several bacteria groups Staphylococcus and E. coli was strong. ZnO-NPs. Agar diffusion tests were used to confirm antibacterial activity.

Application of Nanoparticles

Because of its high antibacterial action, nanosilver (NS), which is made up of silver nanoparticles, is drawing interest for a variety of medicinal applications. Recently, it was discovered that NS contains anti-inflammatory properties and enhances wound healing, which could be used to develop better wound and burn dressings. The multiple methods through which NS operates on germs is the key to its broad-acting and powerful antibacterial activity. To lower nosocomial infection rates, this is used in antibacterial coatings on medical devices. Many new synthesis strategies for NS manufacture for medicinal purposes have emerged and are being studied. The toxicity of NS is also critically discussed in order to reflect on potential difficulties before its broad use in medicine [20].

1- Drug Distribution

A fundamental difficulty by means creation as well as the design of new medication delivery systems are delivering medications correctly also care for their intended destination areas at the exact proper moment to provide a regulated statement with extreme therapeutic efficacy. To reach target cells, targeted nanocarriers must pass through blood-tissue barriers. They need to pass in goal cells through a particular Passage via endocytosis and transcytosis processes across cellular barriers in order to engage cytoplasmic targets. [21].

The blood-brain barrier and the skin's tight epithelial contacts can be circumvented with nanoparticle medication carriers. which ordinarily prevent medications from reaching their intended target. Second, nanocarriers have superior pharmacokinetics and biodistribution of therapeutic drugs because of their large surface area to volume ratio, and hence limit toxicity through preferring an increase in goal spot. [22]. They make hydrophobic substances more soluble and hence appropriate for parenteral delivery. Furthermore, they improve the stability of peptides and oligonucleotides, among other medicinal agents. [23].

Biocompatible Fe3O4 magnetite and Fe2O3 are two magnetic nanoparticles (maghemite). Directed tumor treatment (magnetic hyperthermia), stem cell sorting and modification channeled medicine administration, gene therapy also DNA analysis, and MRI have all been examined. [24]. the toxicity of magnetosomes from Magnetospirillum gryphiswaldense on mice fibroblasts in vitro and originate that the purified and sterilized magnetosomes were not hazardous. [25]. A recent study investigated the effect of natural bacterial magnetic particles on the immunological response of mice lately. Ovalbumin was employed as an antigen in their experiment, which was blended with full Freund's adjuvant, BacMps, and phosphate buffer solution to immunize

BALB/C mice. Antiovalbumin (IgG) titers and subtypes (IgG1, IgG2), T lymphocyte proliferation ability, and expression of IL-2, IL4, IL-10, and IFN-gamma were all measured after 14 days. The findings exposed that natural BMPs have no effect on the immune response of mice and that magnetosomes have the potential to be exploited as new medication or gene carriers in cancer therapy. [26]. Other researchers examine the anti-neoplastic effects of DBMs on hepatic cancer in vitro and in vivo by loading with bacterial magnetosomes (DBMs) on H22 cells: the magnetic bio-nanoparticles as drug carriers. In H22 cell-bearing animals, DBMs, DOX, and BMs showed tumor suppression rates of 86.8%, 78.6%, and 4.3 percent, respectively. Following the administration of DBMs, DOX, and BMs, the mortality rates were 20%, 80%, and 0%, respectively. Both DBMs and DOX efficiently suppressed tumor growth, according to the pathological evaluation of hearts and tumors, however, DBMs had far less cardiac damage than DOX. The DBMs were cytotoxic to H22 cells, causing cell growth and c-myc expression to be inhibited, similar to DOX. DOX, DBMs, and BMs had IC (50) values of 5.309 +/- 0.010, 4.652 +/- 0.256, and 22.106 +/- 3.330 microg/ml, respectively, in target cells. DBMs, like DOX, have anti-cancer properties in vitro and in vivo [27].

Magnetotactic bacteria (MTB) MC-1 with magnetosomes was recycled to deliver the drug. Other scientists employed magnetotaxis to adjust the orientation of each MTB implanted through a mixture of nanoparticles magnetite and the flagella to steer through small-diameter blood vessels. [28] Golden complexes had extensively been utilized by way of therapeutic mediators during human olden times thru the primary evidence reaching belong to Egypt 5000 ages before. AuNPs offer a unique size and shape-dependent optical and electrical properties, in addition to a high surface-to-volume ratio. The surfaces of AuNPs can also be easily changed using ligands containing functional groups that have an affinity for gold surfaces, such as thiols, phosphines, and amines [29]. Golden nanoparticles had appeared such as a viable drug and gene delivery scaffold that can be used in conjunction with more standard delivery vehicles.

2- Antimicrobial Activity

Silver nanoparticles are widely employed as a novel medicinal agent, with antibacterial, antifungal, antiviral, and anti-inflammatory properties. Silver nanoparticles produced by Bacillus licheniformis have anti-angiogenic properties, according to Kalishwaralal et al. [30]. Bovine retinal endothelial cells (BRECs) were cured with various drugs in the occurrence and lack of vascular endothelial growth factor (VEGF). Varying concentrations of silver nanoparticles at twenty-four hours, with 500 nM (IC50) silver nanoparticle solution blocking BREC proliferation and migration. A perfect increase in caspase-3 activity and the creation of DNA ladders were seen in the cells, indicating that apoptosis had been induced. Silver nanoparticles reduce cell survival in BRECs via a PI3K/Akt-dependent mechanism, according to the findings. [30].

The vast majority of NPs are capable of overcoming by minimum one of the most typical forms of resistance outlined in the section (Antibacterial action of NPs) plus the bacterial membranes are disrupted, and this causes a stumbling block of biofilm construction [31]. The bactericidal method of nanoparticles was dependent on their particular physical and chemical features, which causes these effects. NPs, unlike typical antibiotics, have characteristic diameters of less than 100 nanometers. Because of their unusually small size, they have innovative qualities such as increased cell contact owing to a higher surface area-to-mass ratio, as well as a varied and manageable submission [32].

The ways that nanoparticles disorder bacterial membranes are covered in the Antibacterial method of nanoparticles section; alternatively, this section discusses NP interactions with the cell wall and its membrane and bacterial protein synthesis. The bacterial cell membrane is difficult to change with a few genetic mutations due to its extremely preserved environment, limiting the chance of bacterial treatment resistance. [33].

The following are the primary advantages of NPs as a carrier for antibiotic delivery when compared to traditional delivery systems:

- Size: Nanoparticles (NPs) have an ultra-small and controlled size that makes them ideal for antibacterial operations and fighting intracellular bacteria. Because antibiotics have limited membrane transfer, treating infections produced by intracellular bacteria and drug-resistant strains is more difficult with antibiotics. Intracellular microorganisms are thus unaffected by drugs of typical size. To circumvent this issue, an altered usage technique consuming drug-loaded NPs as intermediaries has been proposed. Most forms of NPs are so tiny that they are easily phagocytosed by phagocytes in the host. Furthermore, Most forms of NPs have structures that are appropriate for loud drugs (for example, liposomal NPs, which have one or more lipid bilayers neighboring sphere-shaped NPs), [34].and the elasticity of nanoparticles to arrive at host cells by endocytosis allows furthermost of the drug to stay free intracellularly.
- Protection: nanoparticles transporters dismiss aid to raise antibiotic serum levels and shield antibiotics from target bacterium resistance. As the usage of nanoparticles in medicine grows, so does the number of studies looking into their possible antibacterial actions [33]. Metal NPs, for example, can alter bacteria's metabolic activities. This capability is a large positive in relation to eradicating microbes and curative infections. The capacity of NPs to infiltrate biofilms also provides a realistic way for inhibiting biofilm formation based on gene expression that has been blocked by Ag. [35].

NPs must come into interaction with bacteria parts appropriate to have an antibacterial effect. Contact is defined as electrostatic attraction, van der Waals forces, receptor-ligand interactions, and hydrophobic interactions. The NPs after that pass through the bacterial membrane and aggregate along the metabolic pathway, changing the shape and function of the cell membrane. Following that, NPs interact with DNA, lysosomes, ribosomes, and enzymes in the bacterial cell, resulting in oxidative stress, heterogeneous alterations, and changes in cell membrane permeability, and electrolyte balance in the bacterial cell. Aside from disrupting bacterial membranes, preventing the formation of biofilms is a crucial method, as biofilms play a key role in the development of bacterial resistance. Bacterial biofilms have a particular composition and structure that provides shelter or protection to the germs buried inside them, allowing them to evade most antibiotics. Furthermore, bacterial biofilms serve as a "breeding habitat" for frequent resistance mutations, as well as the exchange and modification of these mutations among bacteria. [35].

One of the most popular antibacterial active materials is metal oxide nanoparticles. ZnO is a novel antibacterial active material with a unique electrical arrangement and appropriate characteristics. Researchers are currently working hard to increase ZnO's antibacterial properties by building a composite using very similar or altered bandgap semiconductor materials and ion fixing. Capping agents including polymers and plant extracts that influence the morphology and size of nanomaterials, as well as adjusting diverse circumstances, improve antibacterial effectiveness. Doping and forming a nanocomposite minimizes electron/hole recombination,

enhances the surface area to volume ratio, and improves dissolving and corrosion stability. The antibacterial activity mechanism is dependent on the release of antimicrobial ions, electrostatic contact, and the production of reactive oxygen species (ROS). This paper also includes a detailed discussion of how to improve ZnO's antibacterial activity by building a composite, doping, and optimizing several parameters. [36]. Silver and silver salts have been used since the dawn of civilization, but silver nanoparticles (Ag NPs) have just lately been discovered. They've been employed as antibacterial, antifungal, and antioxidants in agriculture and medicine. Many bacteria, Bacillus cereus, Staphylococcus aureus, Citrobacter koseri, Salmonella typhi, Pseudomonas aeruginosa, Escherichia coli, Klebsiella pneumonia, Vibrio parahaemolyticus, and Candida albicans are just a few of the bacteria that can cause food poisoning. Have been shown to be inhibited in their growth and multiplication by binding Ag/Ag+ to bio Ag NPs are thought to produce reactive oxygen species and free radicals, which cause apoptosis, cell death, and hinder cell reproduction. Because Ag NPs are smaller than microorganisms, they diffuse inside cells and breach the cell wall, as evidenced by SEM and TEM photos of a nanoparticle suspension containing pathogens. It has also been demonstrated that [37].

3- **Biosensor**

Nanoparticles can be used in biosensor applications because of their appealing optical and electrical properties. Zheng et al. discovered that yeast cells were employed to create Au-Ag alloy nanoparticles, which were then used to fabricate a sensitive electrically chemical vanillin sensor. [38]. Furthermore, electrochemical investigations exposed that a vanillin sensor based on Au-Ag alloy nanoparticles-modified glassy carbon electrode may boost the electrochemical reaction of vanillin five times. Under optimal operating conditions, the oxidation climax flow of vanillin at the sensor increased linearly with its condensation in the size between (0.2–50 M) with a tiny finding limit of 40 nM. This vanillin sensor was used to determine the amount of vanillin in a vanilla bean and a sample of vanilla tea. It's possible that it could be useful in vanillin-controlling systems. AuNP-based glucose oxidase (GOx) biosensors were developed in a separate study based on observations revealing the enhancement of GOx enzyme activity by Au-NPs. [39]. The glucose biosensor has a linear response range of 20 mM to 0.80 mM glucose and a detection limit of 17 mM (S/N = 3). This type of biosensor was used to conclude the glucose content of business glucose injections.

Conclusion

In many environments, bacterial genus exhibited synthesized AgNPs antimicrobial action counter to certain pathogens. Eco-friendly bacteria can also be on a low-cost nanoparticle basis. Biosynthesized nanoparticles could be used in many useful applications and many bacteria and fungi could produce nanoparticles and the studies must be continued in this scientific field.

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