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Quantum Nanoparticles and its Various Applications

Bidyut Prava Nayak[1] Mr.Jyoti Ranjan Mohanty[2], Swagatika Dash[3]
Department of Physics
[1,2]Gandhi Institute for Technology, Gangapada, Bhubaneswar-752054, Odisha, India.
[3]Gandhi Engineering College, BBSR,Odisha.

Abstract-*Nanotechnology is the most important and advanced field of science with lots of practical use . The list of applications and advantages of nanotechnology has grown rapidly and it has the potential to revolutionalizeseveral technology. It has a wide variety of applications in many sectors such as food safety, automobiles, agriculture,energy,health, and environmental safety. These nano particles exhibit completely different characteristics than that of the original structure. Nanoparticles obey all the properties associated with quantum mechanics. These characteristics may lead nano technology to one step ahead in scientific development.This article discusses some quantum characteristic of nanoparticles and applications of nanotechnologyin different fields.*

Keywords: *Nanotechnology, Nanoparticles, Quantum mechanics, Applications*

I. Introduction

Nanotechnology is the understanding and application of matter at the nanoscale, at dimensions between approximately 1 and 100 nanometers having special and novel properties. Encompassing nanoscale science, engineering, and technology, nanotechnology involves imaging, measuring, modeling, and manipulating matter at this length scale.

The unexpected rise in the interest and development of nanotechnology is basically dueto the new and unusual properties of small or nanoparticles. The properties of the material are different at nano scale as compared to the original scale.Matter such as gases, liquids, and solids can exhibit unusual physical, chemical, and biological properties at the nanoscale, differing in important ways from the properties of bulk materials and single atoms or moleculesThe basic reason is that the nanoparticles have a relative larger surface and smaller volume as compared to the original particle.This property of nanoparticles play an important role to exhibit different physical properties and chemical properties. It is also responsible enough to make materials more chemically reactive even though they are inert in larger size. Due to this property, nanotechnology is a famous branch in all the practical applications basically in engineering applications.Nonmaterial applications are also playing a significant economic role as pollutant adsorbents [1], biosensors for monitoring and detection of different compounds [2], and in increasing the efficiency of light sources, motors, electrodes, and efficient wear-resistant material.

Due to this interesting properties of nanoparticles, nanotechnology is becoming the most important part in many scientific and engineering applications starting from agriculture to spacecraft although it has some negative impacts in the point of legal and ethical value. This technology is also very competent enough to fulfill all the requirements of the overgrowing population in the economical point of view. In medical sector, nanoparticles have reacheda milestone in curing many diseases in different manner whether directly or indirectly. The production of foods in a huge amount is also due the new scientific methods and applications of nanotechnology. Many scientific research and development is going on in order to get more benefits from the nanoparticles by some modification in the properties of the nanoparticles.

II. Quantum Mechanics, Nanoparticles And Laser

Since the size of the nanoparticles are very small, their surface area is more in comparison to volume.As a result, they behave differently.They no longer follow the properties of classical mechanics. They experience quantum effect. They follow all the characteristics and properties of quantum mechanics instead of classical mechanics. As a result their thermal property, optical property, electric property and sound property are affected a lot.

On the basis of physics, nanoparticles are the microscopic particles. According to de-Broglie hypothesis, when the microscopic material particles are in motion, they exhibit both particle characteristics as well as wave characteristics. They behave as wave as well as particles. So the wavelength associated with these particles are given by [3]

$\lambda = h/(mv)$,

Where h is Planck's constant, m is the mass of the nanoparticle and v is the velocity of nanoparicle.In this equation the wavelength represents the wave characteristics and the momentum represents the particle

characteristics of the material. So the smaller size of the nanoparticle or smaller momentum of nanoparticle results in the larger wavelength which results in the different applications of nano particle in the near future. From the above expression, it is clear that we can change the wavelength of nanoparticles if the mass is changed. We can get the required amount of wavelength by the suitable choice of mass. If the mass of the nanoparticle is less, then the wavelength will be more. As a result the penetration power is also more. So this property can be used for the LASER beam production. By giving some energy to these nanoparticles, they go to the excited state. But in the excited states they are unstable. But some energy states are called metastable states i.e the rate of spontaneous emission is very low. If this process goes on repeating, population inversion takes place. As a result the number of particle in the excited state is greater than the number of particles in the ground state. The energy emitted by the excited state particle having longer wavelength is used as the source for LASER beam production.

III. Applications And Potential Benefits Of Nanotechnology

In recent years, nanotechnology plays an important role in order to fulfill all the necessity. It has a huge variety of applications in different fields due to its flexibility and potential. The various applications of nanoparticles are discussed.

Medicine

Nanotechnology plays an important role in medicine sector. Due to its minute size, it can be employed as a drug in the particular infected cell of our body instead of damaging other cells. It is also used to deliver vaccine to trigger a strong immune system. It is also used to defeat virus indirectly by producing enzymes.

Food

It has an important application in food sector starting from its growth to packing. It is used for food safety, food quality and food tasty development. It can be used as a sensor to detect the soiled food. Zinc nanoparticles can be used to block UV rays in plastic packaging and to provide anti-bacterial protection [4]. Research is also being conducted to detect vitamin deficiency in our body using nano sensor. It is also used in the farm sector in order to know the water or nutrients deficiency in the seeds or plants.

Cleaner water

Nanotechnology is also used to solve the problems in water quality and pollution in water. The first thing is to remove the waste material from the industrial waste pollution. Nanoparticles can be used to convert the contaminated water to harmless water so that it can be used properly. The second thing is to remove the excess amount of salt and metals from water. The third concern is to use the nanoparticles to detect the virus in water as the standard filters are not able to do such things. Palladium and graphene oxides nano particles are used in this process [5].

Space

Nanotechnology may hold the key to make space flight more practical. Advancement in nano materials make light space craft and capable for the space elevator possible.

Solar cell

Very low cost solar cells can be made by using he method of nanotechnology which is long lasting.

Batteries

Nanotechnology is used in the manufacturing of battery. It is assumed that, the battery made up of nanoparticles havelonger life time.

Electronics

Nanotechnology is also used for the manufacturer of electronic instruments. The instruments made up of nanoparticles have less power consumption and less energy consumption with maximum efficiency.

Fuel cells

Nanotechnology is being used for the production of the production of the fuel containing less pollution and more efficiency. Nano gold particles can be very effective in generating hydrogen from water which is generally used for the production of fuel.

There are many more fields in which the phenomenon of nanotechnology is used. But these are all about the major applications of nanoparticles in different fields.

IV. Conclusion

Nanotechnology is a revolutionary science which will definitely change our future to a large extent. It helps in giving maximum amount of energy from the renewable sources. Nanotechnology has covered a lot of domain today and will cover a lot in the coming future. The value of nanomaterials in many technology areas is

very high because of their versatile properties. Industrial investment in this area is also growing steadily. Today some nanomaterials are already being used commercially Nanomaterials can also be found in sporting equipment, clothing, and telecommunication infrastructure. The future of nanotechnology is boundless and infinite. Some of the items that exist today were a topic of science fiction a decade ago and have the potential to transform our society very quickly and continuously.Therefore in order to promote a sustainable development of nanotechnologies and safeguard the human health, eco-systems it is necessary to assess the risks side-by-side with the nanotechnology research and development.

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