Research & Reviews in Biotechnology & Biosciences **ISSN No: 2321-8681**
Website: www.biotechjournal.in **Mini-Review**
Volume: 8, Issue: 2, Year: 2021 **PP: 71-74**
DOI: https://doi.org/10.5281/zenodo.5775427 **Peer Reviewed Journal**

Metal Quantum Dots

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Article History

Received: 22/06/2021
Accepted: 24/07/2021

Article ID: RRBB/106

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Abstract

In this review we have studied the technology that has emerged in the last few decades and reached the pinnacle of success**.** MQDs have attracted attention for their extraordinary optical properties and wide utilization in biological studies. Quantum Metal Dots, a technology that has emerged in recent times, is at the peak of the success today. Quantum dots (QDs) are in the category of semiconductor nanocrystals whose radii are less than or close to the exciton Bohr radius(10^{-9} m).QDs are capable in the biological and medical fields to function as a new fluorescent marker, because of their unique photophysical properties like emission spectrum, broad excitation spectrum, tunable emission wavelengths etc. In recent years, QDs made significant progress in quantitative analysis by providing a new approach for determination of chemical content analysis. In general nearly all metals are mostly useful in Quantum Dots Technology. This review focuses on general properties and applications of MQDs.

Keywords:- MQDs, History, Band-gap,Solar Cells, LEDs.

Introduction

History

At the end of the 1970s, Russian physicist Alexei Ekimov of the State Optics Institute Vavilov (Leningrad) synthesized nanocrystals of copper chloride and then of cadmium selenide in a molten glass matrix. He then observed fluorescence and a gradient of colors. These first observations were published in1980. Alexander Efros, another Russian physicist, published in 1982 the first theory aiming at explaining the behavior of these very small crystals by the confinement of their electrons. Inspired by Alexei Ekimov, the American chemist Louis Brus, Bell Labs (Murray Hill, New Jersey) tried and successfully produced nanocrystals, but in a liquid form, to obtain a colloidal suspension. In this way, he obtained the first colloidal Quantum Dots of cadmium sulphide, easier to handle, and published his results in 1983.

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Metal Quantum Dots

A vast number of engineered nanoparticles like CNTs, metal oxide nanoparticles, quantum dots, fullerenes etc are widely used in various consumer products such as cosmetics, paints, computer electronics, sunscreen and drug delivery systems.[1-5] QDs also known as semiconductor crystals are a class of inorganic fluorophores with outstanding photophysical properties are being used in industry and in medical.[6] Recent study shows QDs have potential application of image sensors.[7-8] The unique properties of QDs like broad absorption spectra, narrow emission spectra, photo stability and high quantum yield etc.. QDs have wide applications.[9] The study of few atom metal clusters has attracted interests because they bridge the properties of the isolated atoms to nanoparticles and even to the bulk.

Quantum Dots (QDs) are semiconducting nanocrystalline materials with a diameter 2 to10nm.Quantum Dots exhibit distinctive colors depending on the size of particles. The energy of Quantum Dots is related to the size of the Band Gap. Band Gap is a very critical parameter in many electronic and optical applications. While returning electrons from conduction band to valence band release photons with the amount of energy equal to the bandgap. According to Quantum mechanics energy of photons is related to the wavelength(colors) of photons [11]. Different sizes of Quantum Dots result in quantum confinement and hence different BandGaps. Different band gaps of quantum dots result in emission of different colors.

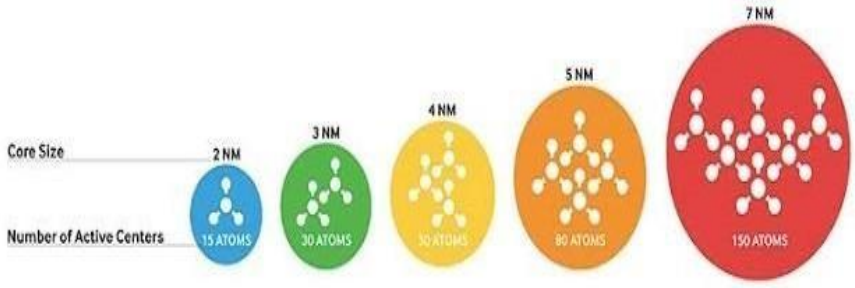

Fig. Energy level

Quantum dots commonly consist of a metalloid crystalline core(e.g., cadmium selenide) surrounded by a shell (e.g., zincsulfide).The fluorescent properties of quantum dots offer a number of advantages for their use in optical imaging. The brightness of quantum dots is 10–100 times greater than most organic dyes or proteins. Quantum dots also show broad absorption characteristics with narrow- emission spectra that are continuous and tunable due to quantum size effects. Quantum dots also possess a long fluorescence lifetime and undergo negligible photobleaching. Most importantly perhaps, quantum dots canbe labeled to allow precise targeting of cellular structures .The properties of dot are not quantum only determined by its size but also by its shape, composition and structure for instance if its solid or hollow their optoelectronic and fraction of

properties change both size and shape. Quantum dots have properties intermediate between semiconductors and

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discrete atoms or molecule. However dimensions of Quantum dots depend on material used to prepare them[12-14] .

Carbon quantum dots have already shown immense potential to play a big Role in nanotechnology For development of assays, Sensors bioimaging agents, During carrier phototherapy, photocatalysis and electrolysis. Despite fact that many Optical and electronic properties of carbon quantum dots are not well understood yet, there is no doubt that MQDS will play huge role in bioimaging and biomedical sciences. Research in near future open upon further development So carbon quantum dots study is very essential in the future.

Application

1. SolarCell

Solar energy is a very important gift from nature, and we must use it properly. Quantum Dot is a very successful resource for converting energy from the sun. This was made possible by Quantum DotsSolar cells are a very useful application in Quantum Dots technology.

The Solar cell design by Quantum Dots that uses Quantum Dots as the absorbing photovoltaic material. It attempts to replace bulk material such as Si, Cu, and Indium Gallium Selenide (CIGS) or Cadmiumtelluride(CdTe).This property makes Quantum Dots attractive for multi-junction solar cells. Where the various materials are used to improve efficiency by harvesting multiple portions of the solar spectrum.

2. LEDs

Quantum Dots are very useful inLEDs. By changing the material size and shape of each Quantum Dots different (colors) wavelengths of lights are emitted.

Quantum Dots in which large dots create red light whereas smaller dots create blue light. This cell can be used to create Quantum light Emitting diodes. With the ability to turn color Quantum light diodes have the potential of solving color consistency and quality issues that have plugged standard LEDs [5-6].These Quantum Dots can range in size from 2nm to 20nm and these tiny dots combine to create a large cell. Which can be useful in a variety of LCD displays.

Laser

The Quantum Dots are useful in lasers. Development of a quantum dot laser that succeeds in minimizing temperature-sensitive output fluctuations, which was not possible with semiconductor lasers in the past [8]. The newly developed quantum dot laser achieves high-speed operation of 10 gigabits per second (Gbps) across a temperature range of 20°C to 70°C without electrical current adjustments, and has minimal output fluctuations caused by changes in temperature.

Funding

No

Ethical issue

No

Conflict of interest

no

Acknowledgements

authors want to thank institute for support

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