Applications and Properties of Gold Nanoparticles

Manu Mitra*

Department of Alumnus with Electrical Engineering, University of Bridgeport, Bridgeport, USA

***Corresponding author:**

Manu Mitra

Department of Alumnus with Electrical Engineering, University of Bridgeport, Bridgeport, 126 Park Avenue, Bridgeport, CT – 06604, USA.

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INTRODUCTION

Gold nanoparticles are used for medical applications rather using elements such as platinum which can be lethal in certain circumstances. Forming gold into nanoparticles allows to use areas that are too small to reach which brings new potential and capabilities.

For Gold nanoparticle application, it has some clear advantages – when gold nanoparticles are very small with a diameter of 5 nm or less, they can used as catalyst; for instance transform air pollutants into harmless molecules. Gold nanoparticle can also be used to treat diseased regions of the body such as cancer tumors and other molecules such as therapeutic drug molecules. Another interesting property of gold nanoparticle; it has ability to convert certain wavelengths of light into heat [1].

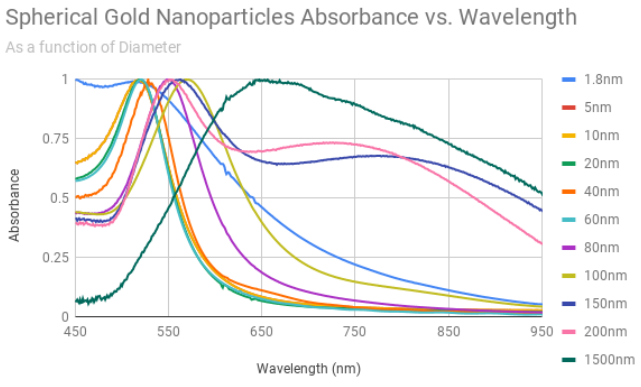

Figure 1: Illustrates spherical gold nanoparticle graph with Absorbance vs Wavelength [2].

New Method of creating gold particles in water

Gold is well known as a noble metal because it is relatively unreactive. Unlike base metals like copper and nickel, gold is resistant to corrosion and oxidation. At nanometer scale gold particles are chemically reactive and make exceptional catalysts. Gold nanostructures are found in various applications including drug delivery, bio imaging, bio sensors and toxic gas detection.

As per scientist, who made the discovery: they found new way of creating gold nanowires and nanoparticles using water droplets. From previous analysis, they knew that chemical reactions proceed faster in micro droplets than in larger solution volumes. Scientist observed that gold particle grew over 100,000 times faster in micro droplets. Nevertheless, the most interesting examination was made when running a control analysis in which they replaced the reducing agent, which discharges the gold nanoparticles with micro droplets of water [3,4].

Gold nanoparticles in solar energy storage

In this study, academics used visible and infrared light that allows gold nanoparticles to absorb it faster and then transfer few electrons generated as a result of the light concentration to neighboring materials like titanium dioxide. Scientist coated gold nanoparticles with titanium dioxide and uncovered the material to infrared, ultra violet and visible spectrum of light. They studied how electrons move gold to the material. The Scientist found that the electrons which trigger reactions created hydrogen from water over four times more efficiently than previously which was validated. Hydrogen can be used to store solar energy and then used for energy in the absence of sun [5,6].

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Liquid Gold Particles

University scientist discovered that liquid gold looks like on the nanoscale and mapped the way in which nanoparticles melt. Research team used gold in their analysis. They arrived their results by mirroring gold nanoparticles with diameters ranging from 2 to 5 nanometers using aberration and corrected using scanning transmission electron microscope. Their analysis were sustained by large scale quantum mechanical simulations [7,8].

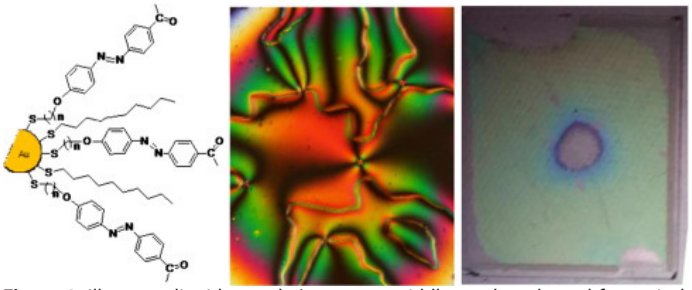

Figure 2: Illustrates liquid crystals (texture at middle can be adopted for optical storage devices (ITO cell at right image). Gray color spot in the middle of ITO cell is the UV irradiated area which is disordered isotropic phase whereas greenish area is protected from the light by mask [9].

"Unzipping" DNA USING GOLD nanoparticles

Research team presented gold nanoparticles approximately 1.5 nanometers in diameter into a solution containing double stranded DNA. Nanoparticles were covered with the layer of organic molecules called ligands. Few of ligands held positive charge, while others were hydrophobic – they were repelled by water. Gold nanoparticles had a minor positive charge from the ligands and DNA is always negatively charged. Hence DNA and gold nanoparticles were dragged together into complex packages.

This research is also relevant to research on DNA based electronics which enables to use DNA as a pattern for creating nano electronic circuits [10,11].

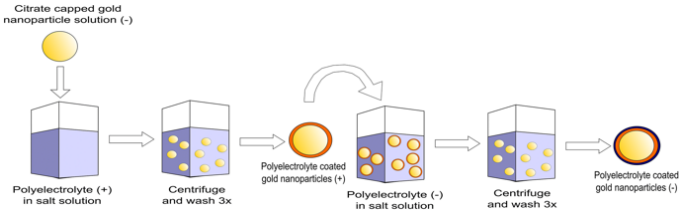

Figure 3: Illustrates Method for self-assembly of polyelectrolyte-coated citrate capped gold nanoparticles using the LbI method [12].

Electro crystallization in Gold nanoparticle

In this research X-ray single crystal diffraction analysis of gold nanoclusters that are composed of a core; formed of dozens gold atoms which are covered and protected by a layer of molecules. It has intrinsic limitation that good quality single crystals are very hard to attain. Then research team developed an electrochemical technique that lets growing high purity crystals in big quantities and are very high crystallographic quality. By giving a very small current to flow between two electrodes, dense forest of millimeter long crystals can be created directly onto the electrode surface [13,14].

Conflicts of Interest

There are no conflict of interest as per Author's point of view.

REFERENCES

1. Perch H (2019) Gold Nanoparticles [Internet].
2. Nanopartz (2019) Spherical Gold Nanoparticles [Internet].
3. Lee JK, Samanta D, Nam HG, Zare RN (2018) Spontaneous formation of gold nanostructures in aqueous microdroplets. Nat Commun 9(1): 1562.
4. Stanford University (2018) A novel way of creating gold nanoparticles in water. ScienceDaily [Internet].
5. Atta S, Pennington AM, Celik FE, Fabris L (2018) TiO2 on Gold Nanostars Enhances Photocatalytic Water Reduction in the Near-Infrared Regime. Chem 4(9): 2140-2153.
6. Rutgers University (2018) How gold nanoparticles could improve solar energy storage: Rutgers study opens door to broader use of sunlight and advanced materials to combat climate change. ScienceDaily [Internet].
7. DM Foster, Th Pavloudis, J Kioseoglou, RE Palmer (2019) Atomic-resolution imaging of surface and core melting in individual size-selected Au nanoclusters on carbon. Nat Commun 10(1): 2583.
8. Swansea University (2019) Liquid gold on the nanoscale: Researchers map how gold nanoparticles melt. ScienceDaily [Internet].
9. Rahman ML, Biswas TK, Sarkar SM, Yusoff MM, Yuvaraj A, Kumar S (2016) Synthesis of new liquid crystals embedded gold nanoparticles for photoswitching properties. J Colloid Interface Sci 478: 384-393.
10. Justin G Railsback, Abhishek Singh, Ryan C Pearce, Timothy E McKnight, Ramón Collazo, et al.(2012) Weakly Charged Cationic Nanoparticles Induce DNA Bending and Strand Separation. Adv Mate 24(31): 4261-4265.

11. North Carolina State University (2012) Gold nanoparticles capable of mnmnmnmn 'unzipping' DNA. ScienceDaily [Internet].

12. Fuller MA, Koper I (2019) Biomedical applications of polyelectrolyte coated spherical gold nanoparticles. Nano Converg 6(1): 11.

13. Antonello S, Dainese T, Pan F, Rissanen K, Maran F (2017) Electrocrystallization of Monolayer-Protected Gold Clusters: Opening the Door to Quality, Quantity, and New Structures. J Am Chem Soc 139(11): 4168-4174.

14. University of Jyväskylä (2017) Electrocrystallization: Breakthrough in gold nanoparticle research. ScienceDaily [Internet].

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