Gold Nanoparticles as A New Tool for Lighting Trees

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ABSTRACT

When we talk about futuristic architecture we're talking about a new concept of aesthetics through technological advances. It is not based on old perspectives; rather, it has new directions and unclear horizons. The goal is to achieve maximum performance with minimal environmental impact. The use of modern materials has changed the architectural concept to make materials lighter, more efficient and less environmentally impacting.

In addition to the traditional static conception of space, our task is to study the impact of emerging technologies on architecture and their applications... They are the key element of this new architectural language. The primary themes from static compositions arranged on basic tectonic principles have been greatly changed to becoming the new subject of a new composition.

Nanotechnology and its applications represent a classification that challenges classification as a model architecture. It proposes a new concept that has a radically different appearance from almost any existing architectural element. By placing gold nanoparticles inside tree leaves, it causes them to give off a reddish glow.

This research suggests using gold nanoparticles to light trees. We are replacing street lights with light-emitting trees (that's a great idea).

KEYWORDS:

Gold Nanoparticles – Nano Technology – Light Trees - Futuristic Architecture.

1- INTRODUCTION

The world has moved towards achieving the principles of sustainability in architecture because it is one of the areas that negatively affect the environment. Nanotechnology studies materials at a very small level in order to control the properties and interaction of these molecules in order to improve the properties of materials or add a new property or produce a new product.

Our task is to study the impact of emerging technologies on architecture and its applications. The emergence of nanotechnology and its rapid development led to the discovery of modern materials that affect the architectural concept and change its style. The research sheds light on nanomaterials that have caused a great development in the field of nanotechnology, namely gold nanoparticles. It is a wonderful nanotechnology material, which produces highly efficient LED-like illumination, but without the use of toxic chemicals such as phosphor powder. Scientists stimulate chlorophyll in the leaves to produce a red emission **[1],** under the high wavelength ultraviolet. The idea of using incandescent trees as an alternative to street lighting would save electricity costs and reduce carbon dioxide emissions. Not only do these gold nanoparticles look cool - they may one day serve as microscopic power stations for molecular machines.

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2- SEARCH PROBLEM:

1- The shortcomings in the use of nanotechnology in Egypt and its failure to apply it in most fields despite its importance.

2- The use of toxic chemicals such as phosphorous powder for the manufacture of LED street lighting and its negative impact on the environment.

3- The consumption of large electrical energy to light the pedestrian paths.

3- OBJECTIVES OF THE STUDY:

1- Supporting the modern architecture system by using light trees that are environmentally friendly and generate light in the corridors and streets for pedestrians.

2- Benefiting from modern technologies such as gold nanoparticles to light trees and beautify the corridors in the Green River area.

3- Produces highly efficient LED-like illumination, but without the use of toxic chemicals such as phosphor powder.

4- Using incandescent trees as an alternative to street lighting would save electricity costs and reduce carbon dioxide.

5- A proposal to illuminate the streets of the Green River to spread the spirit of creativity and innovation.

4- DESCRIPTION OF GOLD NANOMATERIALS:

Nanoscience is the new science through which atoms are manipulated in order to obtain new properties of materials. A nanometer for a meter is equal to a billion parts of a meter. Therefore, the behavior of the atoms differs when authorized, and it has new properties that it did not have, and it is in its natural size. **[2]**

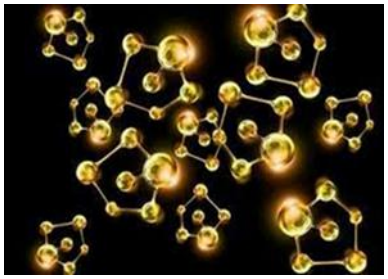

Fig 1: The Shape Of Gold Nanoparticles

For Example, (gold): It has a bright yellow color, but when it moves to the nano size, its color turns (red or green) and the atoms behave in a behavior that is completely different from their normal behavior. This is due to the interaction of the atoms with light in the nano size. Also, gold is a good conductor of heat and electricity and is not a conductor of light in its natural size, but when it moves to the nanoscale, the atoms start absorbing light and can convert it into heat.!! What would happen if we put nanoparticles of gold in the leaves? This is what will be explained. **[3]**

5- THE HISTORY OF NANOPARTICLES

Gold nanoparticles have been used since the Middle Ages by adding these particles to glass to obtain colored glass. The idea comes from the fact that the gold in its original size is yellow,

this is its natural color. But when it is in the size of nanoparticles, its color changes according to the size of the particles. If the size of gold nanoparticles is 25 nanometers, its color is (red). If its size is 50 nanometers, it will be green. If it is 100 nanometers in size, it will be orange in color. These colors come in many stained glass for cathedrals. **[4]**

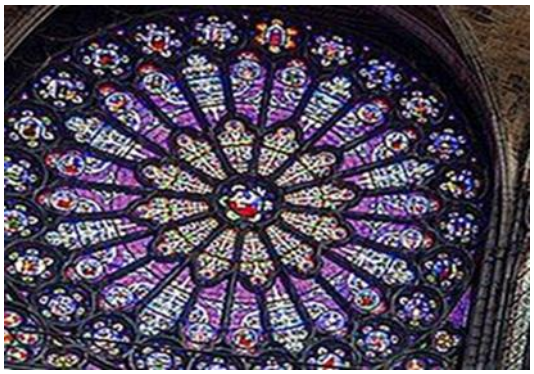

Fig 2: Gothic Stained Glass Rose Window Of Notre-Dame De Paris. The Colors Were Achieved By Colloids Of Gold Nano-Particles.

6- TREES LIGHT UP WITH GOLD NANOPARTICLES:

The discovery that gold nanoparticles can induce luminescence in leaves has opened up the prospect of using roadside trees as streetlights.

Dr. Yen-Hsun Su is a former student of the Department of Physics at National Cheng Kung University (NCKU) in Taiwan where he was supervised by Prof. Wei-Min Zhang of Department of Physics and Assistant Prof. Shih-Hui Chang of Institute of Electro-Optical Science and Engineering.

Yen-Hsun Su of Research Center for Applied Science (RCAS), Academia Sinica, Taiwan, implanted gold nanoparticles into Bacopa Caroliniana plants and found that, when exposed to high wavelength ultraviolet light, the gold nanoparticles can produce a blue-violet fluorescence that triggers a red emission of the surrounding chlorophyll.

Upon learning of the discovery, Assistant Prof. Shih-Hui Chang said: "Light emitting diode (LED) has replaced traditional light source in many display panels and street lights on the road. A lot of light emitting diode, especially white light emitting diode, uses phosphor powder to stimulate light of different wavelengths. However, phosphor powder is highly toxic and its price is expensive. As a result, Dr. Yen-Hsun Wu had the idea to discover a method which is less toxic to replace phosphor powder which can harm human bodies and cause environmental pollution. This is a major motivation for him to engage in the research at the first place. **[5]**

In nature, there are some trees that glow as a result of fungi and bacteria, for example the guava tree **[6].** The researchers began to try to light trees in another way using modern nanotechnology. They chose gold nanoparticles that are in the shape of a sea urchin known as bioluminescent diodes (BLEDs). This special shape of gold nanoparticles is responsible for converting gold from a substance that absorbs light in a Natural way to light radiant material.

Not only are they gorgeous looking gold particles, but they will be able to be a source of light one day. The chlorophyll in leaves is the pigment that gives them their distinctive green color. This dye absorbs specific wavelengths of light, about 400 nanometers at which the chlorophyll can produce its own light (red light).

When wavelengths shorter than light invisible to the human eye strike gold nanoparticles, they get excited and begin to glow violet. This violet light hits the neighboring chlorophyll molecules and excites chlorophyll, resulting in this glow.

They succeeded in manufacturing nanoparticles and planting them in the leaves of the trees, and the tests were limited to a plant known as (Bacopa Caroliniana) to stimulate bioluminescence in this plant. Su was able to stimulate the chlorophyll in the leaves to emit red light by using gold nanoparticles in the form of sea urchin NSU. **[7], [8]**

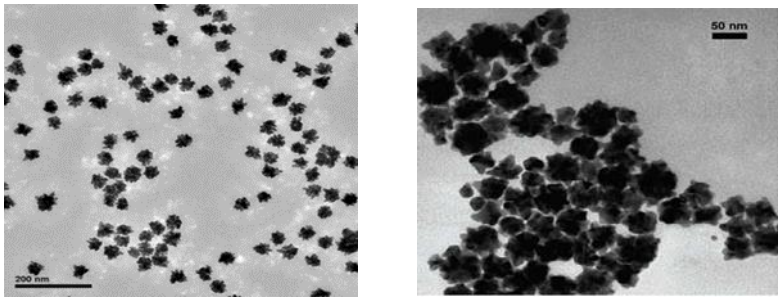

Fig3: Gold Nano-Sea-Urchins

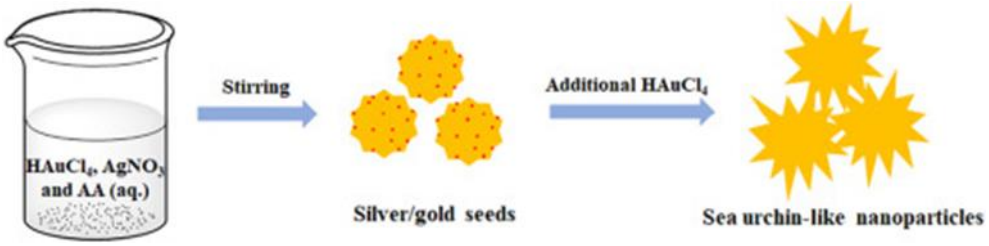

Fig4: The Formation Of The Process Gold Nanoparticles

Fig 5: Experiment With Implanting Gold Nanoparticles In Leaves

7- Experiment:

After immersing the Bacopa leaves in gold colloid for five days, the images of Bacopa leaves under white light and UV light (285 nm) captured with an Olympus optical system are shown. The left-column images of **Fig 6** show that the gold nanostructures in Bacopa leaves scatter strongly under white light radiation. The positions of gold nanostructures can be identified as the bright spots.

The photoluminescence spectra of Bacopa leaves with and without gold nanostructures under 285 nm radiation are shown. When the Bacopa leaves without gold spherical nanoparticles are illuminated using 285 nm ultraviolet light, bioluminescence of the plant is not observed. In addition, the chlorophyll fluorescence of the plant with gold spherical nanoparticles is weak. On the other hand, after immersing the leaves in Au NSU colloid, the bioluminescence of Bacopa becomes observable. As the size of Au NSU increases, the intensity

of bioluminescence gets stronger. In addition, the bioluminescence of Bacopa appears near the positions of gold NSUs. **[9]**

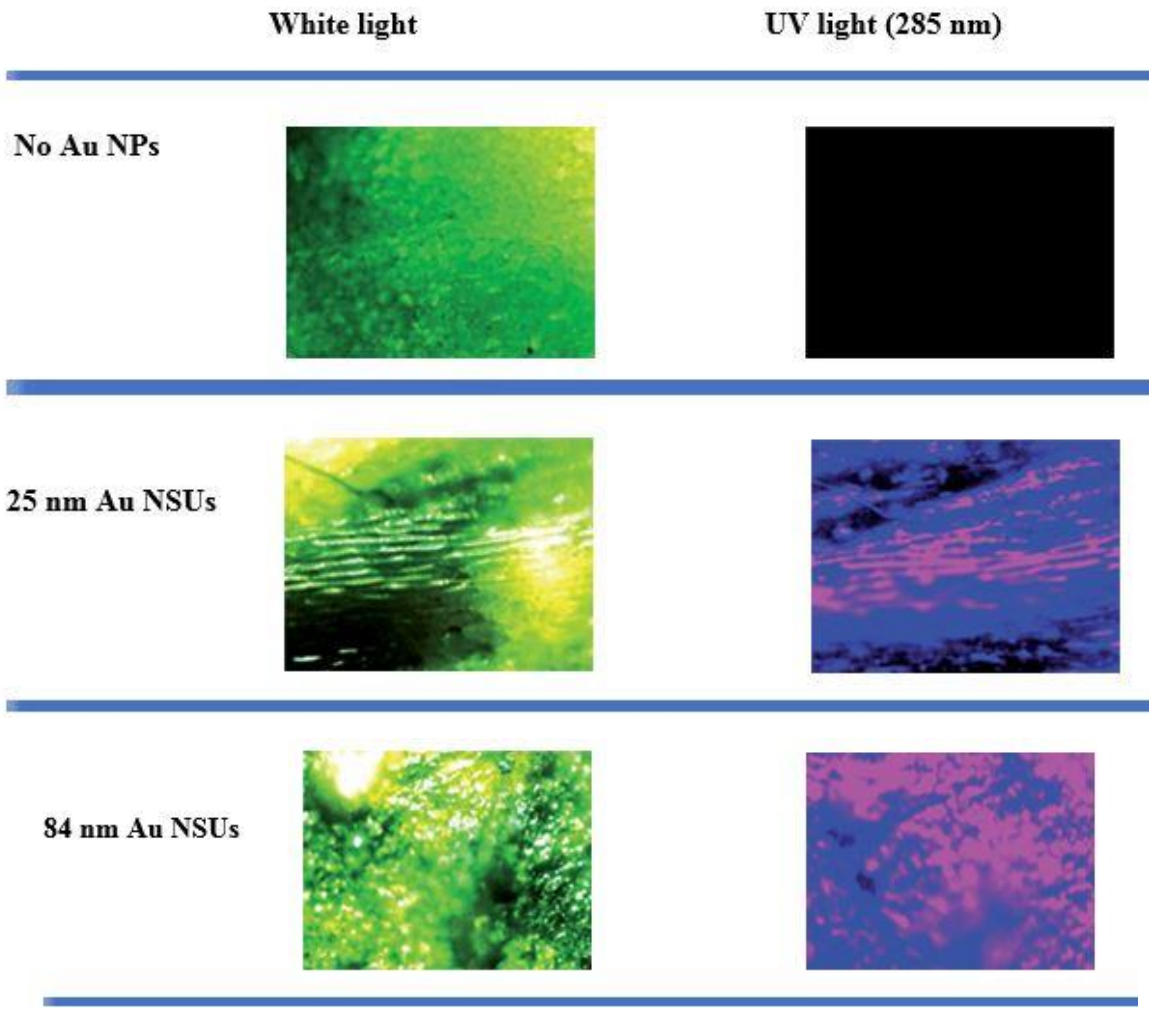

Fig 6: Dark Field Images of a Nanostructures On (Bacopa Caroliniana) Leaf Radiated with Different Light

8- A proposal to apply this technique to trees in the streets of (Green River) in the new capital

٨،١ About the Green River and why did you recommend this place?

The Green River area in the New Administrative Capital, which was described as "the longest chain of gardens in the world." It is a park in the middle of the city with an area of more than a thousand acres, with a length of more than 10 km.

Fig7: The Green River In The New Administrative Capital

35 km along the Green River, the 6 neighborhoods of the new administrative capital directly overlook the Green River, and a new type of desert landscape was used to reduce water consumption. Why don't we save electricity too?

Street lights are part of the infrastructure. If we were able to use natural street lamps that do not need electricity, then we have succeeded in achieving architectural sustainability and preserving the environment. **[10]**

This will make the trees glow at night. So, it is a great idea to replace street lights with bright trees at night. it will not only save electricity but will reduce pollution from LED and reduce carbon dioxide emission and will reduce light pollution in the streets of the green river.

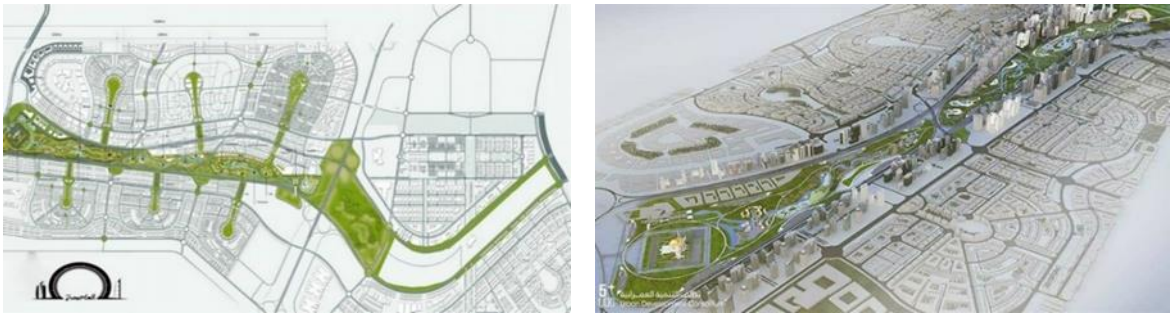

Fig ٨: It Is Required To Achieve Architectural Sustainability In This Area And Preserve The Environment.

When the lights are glowing, they are useful for pedestrians and give a great view with reducing costs, reducing pollution and creating sustainability in that place. This is a new idea to discover a less toxic way of using phosphorous powder in LED. and this is what you hope to achieve in the green river streets for pedestrians.

Fig 9: This Idea Will Be Applied to Trees in Private Streets for Pedestrians Only

This proposal will be applied temporarily to trees for pedestrian paths only. Because the resulting lighting that the researchers reached is not enough to light public streets. But with the research development and continuous adjustment at the atomic level, we will reach better results in the future. At first, it will become expensive, as this nano-material is not cheap in Egypt.

Where the price of (5 mm) of gold nanoparticles is equivalent to (400) Egyptian pounds **[١1].** But when we reach the final result, which is lighting at night without the need for electricity, this material value will be returned, in addition to the aesthetic form that will distinguish the green river corridors after applying this technique to it.

fig 10: image of the glowing tree (in jinju, south korea) shape after being injected with gold nanoparticles. [12]

9- Visions for the future:

For future visions of this technology, the researchers hope to develop a way to paint or spray nanoparticles onto plant leaves, which could make it possible to turn trees and other large plants into light sources. Such architecture would reflect new geometries, blurred horizons and the disappearance of defined forms. **[13]**

The pursuit of lightness, fluidity, virtuality and maximum performance with minimum use of materials could be used to benefit future architecture by developments of new structures and surfaces with new geometrical form.

١٠ -CONCLUSION

This research sheds light on the idea of using nanomaterials with different properties and multiple shapes to achieve sustainability and preserve the environment. Hence, gold nanoparticles in the form of sea urchins were used to be injected into the tree leaves and interact with it to make the trees glow. Hence the idea of replacing the street lamps for pedestrians with glowing trees with a wonderful view.

The new theory predicts that there is huge commercial potential in replacing the street with natural bioluminescent systems. The idea is also extremely environmentally friendly as no electricity would be required and the process which produces the photons of light is extremely energy- efficient.

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