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The Sustainable Knowledge Driven Approaches in the Advancement on Artificial Photosynthesis Research

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Abstract:- The introduction and scientific advancements in the artificial photosynthesis research aimed at achieving great potential by developing products that supplement our natural tree and forest plantations and in all scenarios for sustainable energy. The ever increasing incidences of carbon dioxide emissions by burning of fossil fuels remains the predominant driving force of global warming and related climate changes which have greater potential of catastrophic consequences, therefore its important that the current generation focus on the need to sustain nature, create a sustainable future or counter the incidences of ever increasing global warming in the globe, this also means that this generation have to change the production system both in the industrial production process and our living environment by adopting the technologies that supplement the role of natural tree plantations in the universe. This call for further research in many areas including advancing in the area of articial photosynthesis technology. The humanity has been and is always using solar energy artificially in many ways for instance the process of generation of electricity by the application of the photovoltaic solar panels, the process of installation of the solar collectors on building roofs for heating water, the process where solar energy is used artificially is the cultivation of plants and algae for the production of food and biofuels and many other aspects.The artificial photosynthetic technology ought not to be ignored by both developed and developing countries bearing in mind that we are living under one universe and the technology will offer greater solutions to adequately address the global warming menace. This publication is aimed at informing the general public on the essentials of sustainable approaches in the advancements on artificial photosynthesis research around the globe.

Keywords:- *Artificial Photosynthesis, ATP, Photons,Anoxygenic, Phototrophic.*

I. INTRODUCTION

The photosynthesis process is essential natural process that keeps everything in the universe alive; this happens when plants absorbs sunlight energy and use it to convert carbon dioxide and water into carbohydrates and emit oxygen to the atmosphere. The novel technology that mimic the naturally photosynthesis process is known as the artificial photosynthesis; the technology aims to split water into its hydrogen and oxygen and carbon components using sunlight. Therefore the hydrogen gas produced via this process is readily used in the fuel cells or solar energy. The total solar energy absorbed by the earth is approximately 3,850,000 exajoules per year (1).

For one to better understand the concept of photosynthesis, primarily one should have better understanding of phototrophy; this is the process which living organisms traps photon and store energy in form of chemical in the form of adenosine triphosphate (ATP). The ATP transports chemical energy within cells for metabolism, there are three types of phototrophy namely; oxygenic, anoxygenic photosynthesis and rhodopsin based phototrophy (2). The anoxygenic photosynthesis the light energy is captured and stored as ATP without the production of oxygen in this process water is not used as primary electron donor, good example of this scenario is seen in the phototrophic green bacteria, phototrophic purple bacteria and heliobacteria, the photosynthetic pigments in the anoxygenic phototrophs is known as the bacteriochlorophyll (8). Unlike in the oxygenic phototrophs, anoxygenic photosynthesis only function using single photosystem thus restrict them to cyclic electron flow therefore unable to produce oxygen from the oxidation of water.

In the photosynthesis process that occurs in the algae, cyanobacteria and plants results not only in the fixation of carbon dioxide from the atmosphere but also release of molecular oxygen to the atmosphere thus the process is known as the oxygenic photosynthesis. It is estimated that this photosynthesis process captures approximately 3,000 EJ per year in biomass and produces more than 100 billion tons of dry biomass annually (3). The photosynthesis process is essential for maintaining normal level of oxygen in the atmosphere making the universe humane friendly environment. The main aspect presented by artificial

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photosynthesis is that the natural photosynthesis process is inefficient. Thus there is need for more research advancements to address the deficit and address ever increasing incidences of global warming. It is evident that by production of non-fossil fuels and valuable products, artificial photosynthetic can assist in the reduction of carbon dioxide emissions which in conjunction with other factors are greatly contributing to global climate change. The artificial photosynthesis technology advancements for production of non-fossil fuels will be capable of outcompeting fossil energy and this is a long term global perspective in reducing climate gas emissions.

II. ESSENTIALS OF ARTIFICIAL PHOTOSYNTHESIS

In the previous year's many artificial photosynthesis research has been carried out leading to the introduction of novel systems based on the principle of natural photosynthesis however a number of these systems are still in the infancy stage in terms of large scale production, commercialization and even adoption by the global community. The modern researcher ought to focus on what makes the artificial photosynthesis viable souce of renewable energy by focusing on the knowledge driven strategies towards the advancement of the technology; the pricinple addressed in this paper highlights on three major model concepts namely system pathways and product efficiency, systeme robustness and simplified cost effective systems. An efficient artificial photosynthesis system with estimated cut off wavelength of 800-1200 nm makes optimal use of incoming photons and drives water splitting thus fuel production with two photons per electron.

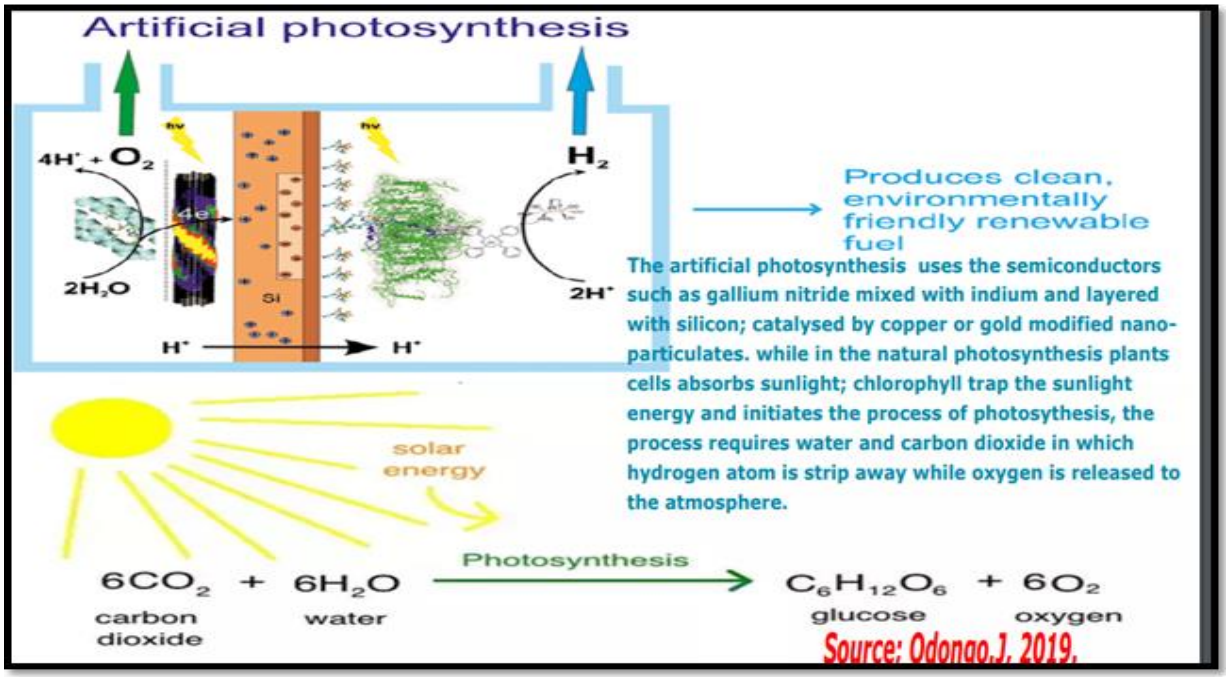

Fig 1:- Describes How the Artificial Process Mimics the Natural Process of Photosynthesis in Plants. In the Artificial Photosynthesis the End Product is a Clean Environment Friendly Hydrogen Which is Renewable and Could be Utilized to Produce Electricity.

In the process of artificial photosynthesis; the higher the quantum efficiency, the less material and surface area is needed. The aspects for the achieving higher quantum effeciency in artificially photosynthesis process was still being consired as a major challenge by researchers a cross the global, however there is still a room for more research in order to attain higher quantum effiency especially in the latest solar cells generation technology. Currently, there are few and very expensive artificial photosynthetic systems that work with a quantum efficiency of more than 25 %, corresponding to an energy efficiency of more than 10 % (5).

The second major aspects for effective artificial photosynthesis is durability, the system need to be durable such that it can transform a lot of energy relative to the energy requirements for installations and maintenance (9). This may pose a greater challenge to the research community since many materials available in the market degrade quickly when exposed to sunlight or corrode when exposed to oxygen or water. However a solution to this may be building systems of very robust materials, like the coated semiconductors that are used in photovoltaic cells or coming up with the system which is self-repairing when there is damage as in the natural process of photosynthesis in the living organisms where components involved in photosynthesis process are regularly replaced.

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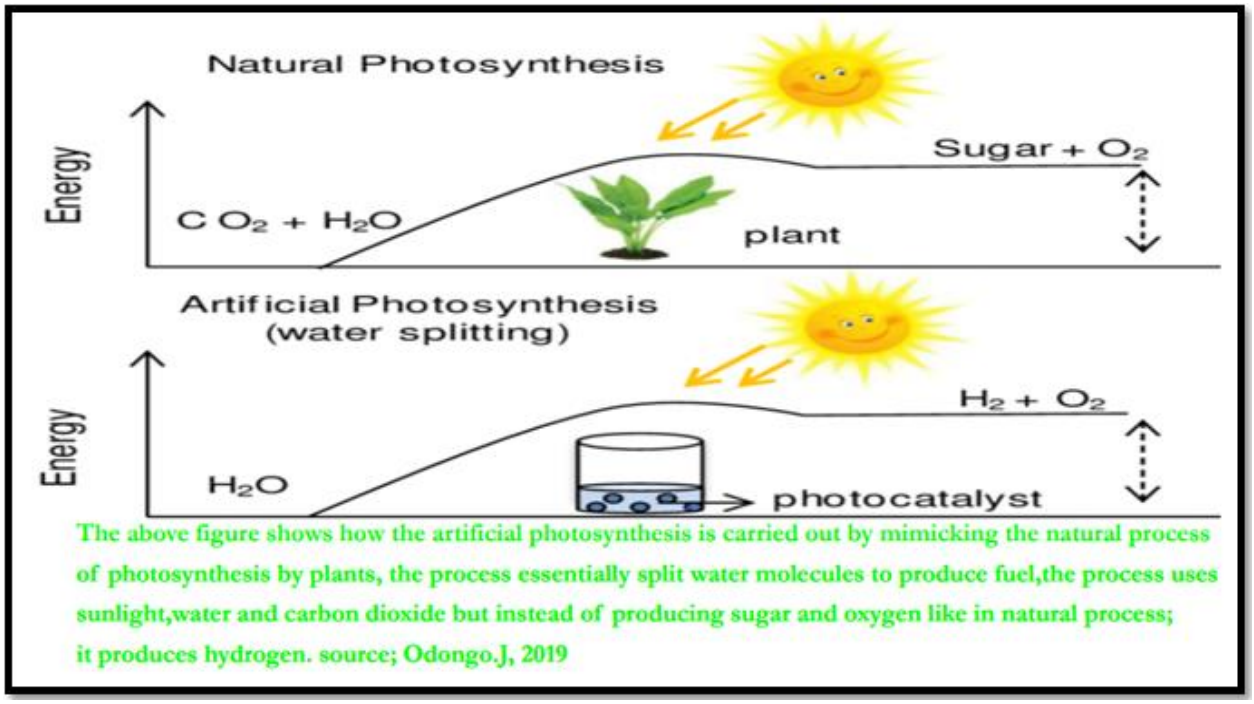

Fig 2:- Showing the End Results Productions where by in the Artificial Photosynthesis the End Products is Hydrogen and Oxygen While in the Natural Process the End Results is Carbohydrate and Oxygen Atom.

The last aspect of effective artificial photosynthesis is cost effective and simplified systems that makes it commercially viable. Scientist and innovators in this area of research must make sure that the final product of artificial photosynthesis is able to supplement and compete with other technologies or innovations in the production of hydrogen and other fuels that are already in the global market, the idea here is to make artificial photosynthesis as cheap as possible and locally available to the public.

➢ *Artificial Photosynthesis Amalgamations*

The artificial photosynthesis research is highly interdisciplinary and incorporate many areas of science and management this is due to its technical, physically, social, ethical, biological, chemical and economical nature to be overcome. The research into this field call for expertise from sub-disciplines within chemistry, such as photochemistry, electrochemistry, materials chemistry, biotechnology and many others (10). Most of the research on artificial photosynthesis incorporate public private partners with the focus on photosynthesis in the cellular systems, chemical photovoltaic reactions and natural photosynthesis in plants.

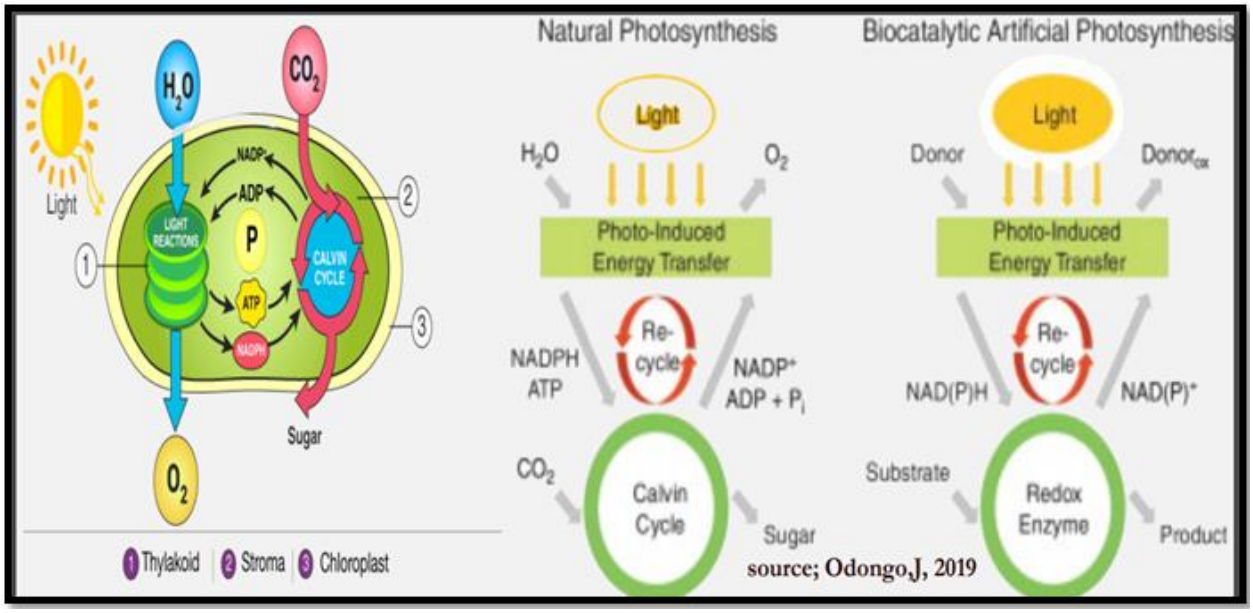

Fig 3:- Showing the Biocatalytic Artificial Photosynthesis Reactions Involving Redox Reaction that Mimic the Calvin Cycle in Natural Photosynthesis in Plants.

Artificial photosynthesis research takes a broader approach by embracing all the interdisciplinary, the research methodology embracing amalgamations into the artificial photosynthesis shall enable researchers to show case genuine progress and promote industry-academia interactions with industrial delegates highlighting their technological requirements and expectations that are economically viable, this will leads to technological implementation towards sustainable development.

III. CONCLUSION

An efficient, robust and cost effective artificial photosynthesis end products could revolutionize the global energy. The artificial photosynthesis could effectively solve the global warming menace since it's a renewable and clean energy with zero carbon dioxide emission. Many research and concepts have prove that artificial photosynthesis can produce products of hydrogen that could be converted into fuels that are of greater benefit to the community. With the efforts scientist the artificial photosynthesis could effective production of storable fuels such as the methanol and methane from natural resource namely; water, carbon dioxide and sunlight. This shall be self-sufficient and renewable clean energy thus solve the greater problem of our time of global warming.

CONFLICT OF INTEREST

The author herein do hereby declare that there is no conflict of interest in the production and publication of this article.

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