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A Dream Technology- Artificial Photosynthesis for Energy -Efficient Food Production

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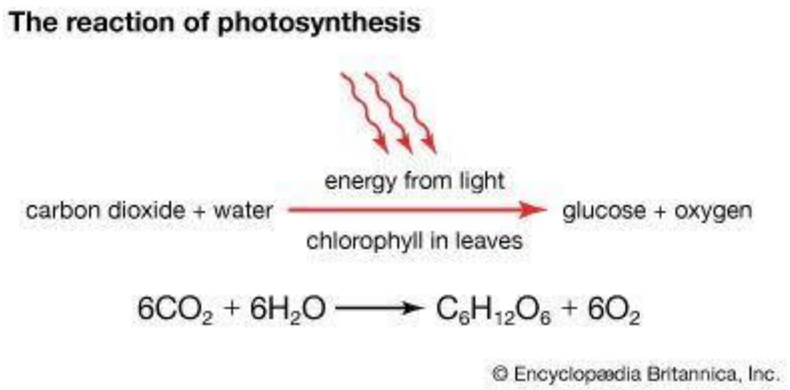
SUMMARY

The energy needs of humankind has experimented a sharp peak since the beginning of the anthropecene due to a large increase in population and dynamic changes of our society life style. Recent projections suggest that it will likely lead to major crisis due to environmental issues associated with the use of fossil- fuel stocks. In order to tackle these problems, the development of artificial photosynthesis system is one of the most appreciating. The field of artificial photosynthesis takes nature itself as a source of inspiration, to propose alternative energy harvesting and storage strategies. The goal of artificial photosynthesis is to use the energy of the sun to make different useful material or high energy chemicals for energy production. In this article author has beautifully highlighted the mechanism and importance of AI.

INTRODUCTION

Life on the earth ultimately depends on energy derived from the sun. Photosynthesis is the only process of biological importance that can harvest this energy. The term photosynthesis means literally "Synthesis using light".Photosynthetic organisms use solar energy to synthesize carbon compounds that can not be formed without the input of energy. More specifically, light energy drives the synthesis of carbohydrates from carbondioxide and water with the generation of oxygen.



Energy stored in these molecules can be used later to power cellular processes in the plant and can serve as the energy source for all forms of life. Sunlight is like a rain of photons of different frequencies. Our eyes are sensitive to only a small range of frequencies- the visible light region of the electromagnetic spectrum. The development and maintenance of life on earth are predominantly dependent on photosynthesis, which transforms the radaint energy, coming from the sun, into the chemical energy stored in various molecules. In photo synthetic eukaryotic organisms, this process takes place in the chloroplast. As the heart of the photosynthesis process are chlorophyll and carotenoid pigments. Chlorophyll biosynthesis starts with the formation of delta-amino levulinic acid, the universal precursor of tetrapyroles.

Approaches to artificial photosynthesis

Artificial photosynthesis involves four stages, making it very similar to natural photosynthesis.

1.Light harvesting.
2. Charge separation
3. Water splitting
4.Fuel production

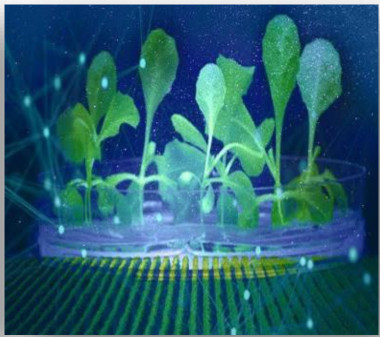
Different approaches are used according to the type of material.

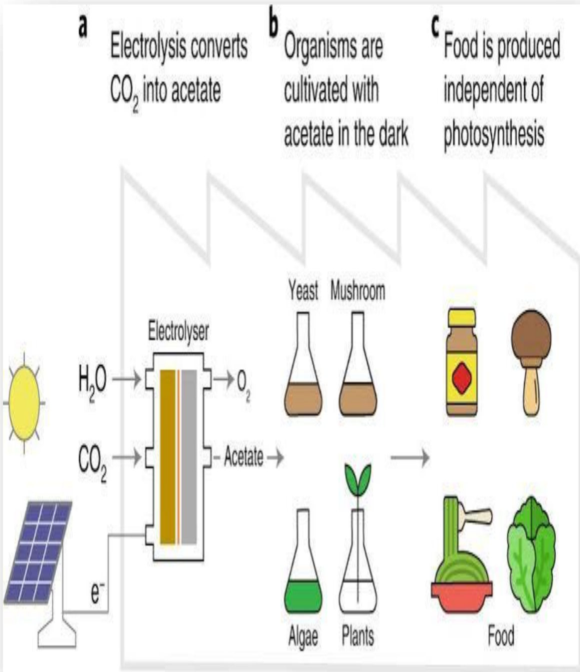
Molecular systems:- Molecular catalysts are often developed following biomimetic approaches.

Inorganic systems:- Photovoltaic cells made of semiconductors can absorb sunlight and sperate electrical charges.

Molecular inorganic hybrids:-An attractive solution is to combine the best properties of organic and inorganic materials.

Photosynthesis however, is very inefficient, with only about 1% of the energy found in sunlight ending up in the plant.





Logistics of Artificial Photosynthesis

Scientists at UC Riverside and the university of Delavare have found a unique way to bypass the need for biological photosynthesis altogether and create food independent of sunlight by using artificial photosynthesis. The researchers grew plants in complete darkness in an "acetate medium " that replaces biological photosynthesis. They used a two- step electrolytic process to convert CO2, electricity and water into acetate. The food producing plants then consumed this acetate to grow.Intrestingly if combined with solar power panels, this system could increase the conversion efficiency of sunlight, upto 18 times more than biological photosynthesis in same food. The researchers used an electrolyser, to convert raw material like CO2 into acetate. Its output was optimised to support the growth of food producing plants by increasing the amount of acetate produced and decreased the amount of salt produced as a byproduct. In the experiments, scientists demonstrated that this technology could be used to grow a wide variety of food-producing organisms in the dark including green algea,yeast and fungal mycelium that produce mushrooms. According to the study published in 'Nature Food' producing algea with this technology, is four times more energy efficient than growing it with photosynthesis. The scientists also tested the potential to use this technology to grow cowpea, tomato, tobacco, rice, canola, and green pea. All plants were able to use the carbon from the acetate medium when cultivated in the dark.

CONCLUSION

By removing/liberating the dependence on the sun, artificial photosynthesis opens the door to countless possibilities for growing food under the difficult conditions that we could see in the future due to anthropogenic climate change , potentially droughts, floods, increase in global food security of crops could be grown in such controlled and efficient environments.

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