

Artificial Photosynthesis using Solar Panel

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ABSTRACT: This paper reviews Moorella Thermoacetica Non-photosynthetic bacterium. First objective is to discuss Moorella Thermoacetica. Second objective is to put forth various experiments done by Chemistry professor Kelsey Sakimoto in achieving artificial photosynthesis which turned out to be way more efficient than natural photosynthesis done by chlorophyll. Till now majority of techniques for achieving artificial photosynthesis require expensive solid electrodes. Whereas this bacteria itself act as a tiny solar panel when coated with cadmium and amino acid cysteine and is able to collect solar energy and turn it into acetic acid with an impressive efficiency of 80%. This acetic acid can be used for various applications.

Also my new concept of making a solar panel which can generate electricity as well as perform artificial photosynthesis at the same time can revolutionize the way the normal solar panel works. Solar panels of today cannot generate electrical energy when there is not sufficient sun light i.e. during evening and night period. Its current density depends on the intensity of sun light to which it is exposed while the sun light which is present during sun set is wasted. This is in the case of electrical energy but in the case of chemical energy, the solar panel will still keep extracting energy from sun and keep producing acetic acid irrespective of intensity of light, climate and time of the day. Also the reason behind bringing this technology into light is to show that it is green, free, hazard free, and unending availability because the solar energy is bountiful in nature.

Combination of Moorella Thermoacetica and Cadmium with amino acid cysteine forms new bacteria M.Thermoacetica-Cds which called Cyborg which as a part of its normal respiration generates acetic acid when it inhales CO₂, light and H₂O. It is totally green and renewable. This acetic acid can be used various sectors such as Polymers, Pharmaceutical, fertilizers and probably in the future shall be used as a biofuel. Tomorrow we may end our dependency of petroleum-based fuels plastic and oil.

KEYWORDS: Artificial Photosynthesis, Solar energy, Chemical energy, Renewable energy, Free energy, perpetual energy, non-conventional energy

I. INTRODUCTION

In today's world the major problems that we are facing are, availability of fresh water, electricity generation without any residue or pollution and most importantly reducing/eliminating pollution. World has energy in various forms such as solar, wind, thermal, chemical, radiation etc. But as we have developed equipment which requires electricity to work, we have to convert this energy available in various forms into electricity, biofuel and more other forms of energies which are clean and free.

At present we have solar energy the most bountiful, clean and free energy and the device which extracts energy from sun in the form of electricity is solar panel. But as the solar panel can convert only 23 to 25% of solar energy into electrical energy to which it is exposed, a lot of amounts of solar energy is wasted. Also when it comes to photosynthesis a green pigment in plants called Chlorophyll uses solar energy and carbondioxide to generate oxygen and starch, but it absorbs only 40% of sun light from which 30% is waste and only 10 to 12% is converted in useful forms.

Moorella Thermoacetica is a bacteria which forms over Hydrogen molecule is a non-photosynthetic bacteria. As a part of its natural respiratory system inhales carbondioxide(CO₂) and generates acetic acid. Several tests were performed by Prof. Kelsey Sakimoto to increase its efficiency and make M.Thermoacetica more efficient. It was observed that when M.Thermoacetica was mixed with Cadmium and Amino acid Cysteine, the bacteria itself formed cadmium sulphate nanoparticles on its surface and acted as a tiny solar panels. The new bacteria M.Thermoacetica-Cds is called as 'Cyborg' bacteria which can now produce acetic acid by consuming light, CO₂, and water. So by placing a thin layer of Cyborg bacteria on solar panel can allow us to generate electricity as well as acetic acid at the same time and when it

comes to acetic acid it is generated at an impressive efficiency of 80% i.e. 80% of sun light to which the panel is exposed to will be converted into chemical energy which will be very helpful for the near future.

II. RELATED WORK

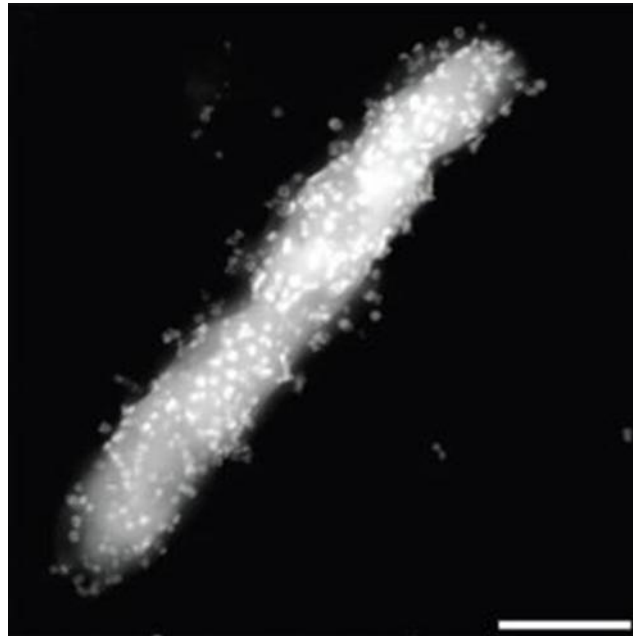


Fig A: M. Thermoacetica with Cadmium Sulphate Clusters (Cyborg)

Artificial photosynthesis was first anticipated by the Italian chemist Giacomo Ciamician during 1912. The Swedish Consortium for Artificial Photosynthesis, the first of its kind, was established during 1994 as a collaboration between groups of three different universities, Lund, Uppsala and Stockholm, being presently active around Lund and the Angstrom Laboratories in Uppsala. Research of artificial photosynthesis is experiencing a boom at the beginning of the 21st century. During 2000, Commonwealth Scientific and Industrial Research Organisation (CSIRO) researchers publicized their intent to emphasize carbon dioxide capture and its conversion to hydrocarbons.

III. METHODOLOGY

The cyborg bacteria were produced with the intension of producing acetic acid by extracting the energy from sun, water and even Carbon-di-oxide to produce acetic acid. It is basically the more efficient upgrade for Moorella Thermoacetica which before produced Acetic acid using carbon-di-oxide. But after coating it with Cadmium Sulphate, cyborg was formed which was 80% more efficient than the standard natural photosynthesis. As it is now capable of producing acetic acid from sun light, a layer of cyborg bacteria can me poured over the surface of solar panel. Now solar panel will not only generate electricity but also will generate acetic acid which can further be used as fossile fuel.

IV. EXPERIMENTAL RESULTS

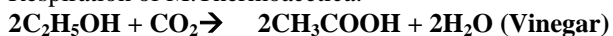
As an Electrical Engineer, I want the solar panels to harvest more energy from sun as energy from Sun is Bountiful and clean.

Prof. Kelsey Sakimoto made a panel consisting of this cyborg bacterias and atracted Sun energy my giving the panels a large area. But instead of making separate panels, a normal solar panel can be covered with a film of Cyborg bacteria due to this a solar panel will not only generate electricity but also will generate acetic acid.

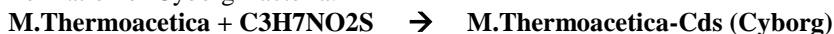


Reactions taking place will be as per following

Respiration of M. Thermoacetica:-



Formation of Cyborg Bacteria:-



Conversion of Light into Electricity:-



Thus, Cyborg bacteria when exposed to light produces green potential fuel.

Applications:

The acetic acid generated by this method can be used in various sectors such as polymers, fertilizers, pharmaceuticals etc.

The primary use of acetic acid is the production of vinyl acetate monomer (VAM). Vinyl acetate can be polymerised to polyvinyl acetate or other polymers, which are components in paints and adhesives.

The major esters of acetic acid are commonly used as solvents for inks, paints and coatings.

This acetic acid in the near future can be used as a biofuel so it would completely eliminate our dependency on petroleum-based fuels and plastic.

V. CONCLUSION

Artificial photosynthesis from Solar panels is a very ideal technique for generating electricity and biofuel (acetic acid). Lot of researches are being done in this field. Cross functional team from Electrical engineering, Chemical engineering, material science should come together and work in this area to come out with a solution to develop artificial photosynthesis which will be at low cost, easy to handle, maintenance free and generate sufficient energy from solar to successfully power the electrical devices and keep providing biofuel in order to minimize our use of plastics and petroleum based fuels. Presently this technology is at very infant stage, but research is being done and soon solution will be available due to which it can be commercialized and made available to use for everybody.

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