Energy Efficiency and Renewable Energy Nanomanufacturing Initiative

“Plus Energy” surfaces by naturally producing hydrogen using algae

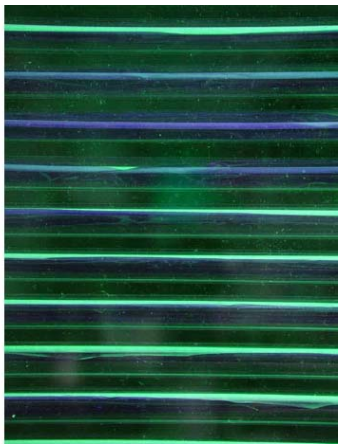
Green algae are producing hydrogen naturally. This natural effect will be used for “plus energy” artificial surfaces.

Hydrogen, manufactured locally using water, wind and sun, is a secure, inexhaustible, emission-free fuel for consumer electronics, heat and electricity production, and the next generation of highway vehicles. It is recognized that green algae is producing hydrogen naturally by dividing water in hydrogen and oxygen. This process is not only CO_2 neutral, comparing the $CO_2 – O_2$ ratio it is impacting with negative CO_2 relation. That means a surface applied with these microorganisms will produce hydrogen by dividing water and produce oxygen as a natural organism like trees.
Without energy input, the organisms are producing hydrogen, which results in a positive energy ratio – “plus energy” surface.
They do so using a cell protein, the enzyme hydrogenise. The energy that is necessary for the process is sourced by photosynthesis. Producing hydrogen is a loss of energy for green algae, so you have to force them to produce hydrogen by depriving them of sulfur. Sulfur is one of the nutrients that enable plants to grow – without sulfur no growth, but photosynthesis continues anyway. Because of the photosynthesis green algae produce masses of energy – the hydrogen. The hydrogen escapes as a gas. Hydrogen is a new future energy source for cars, digital cameras and fuel cells. Hydrogen can be stored without problems as a gas in tanks. It is transported in main pipelines. The development of fuel cells makes it possible for us to decide to create a facade incorporating fuel cells.
This hydrogen facade consists of modules including green algae and fuel cells. The green algae are in tubes between two glass sections. The tubes are perforated and the hydrogen can thus escape into the space between the two pieces of glass. At the top of each facade module is a fuel cell that converts the hydrogen into electricity and heat.

Benefits to the Nation

- Energy efficient housing
- Energy producing surfaces
- Hydrogen production
- CO_2 elimination
- Sulfur elimination
- Decrease Greenhouse Gas Emissions

APPLICATIONS
There are numerous applications in housing, architecture, hydrogen generation, etc…



structures of algae’s and model of a hydrogen surface / facade

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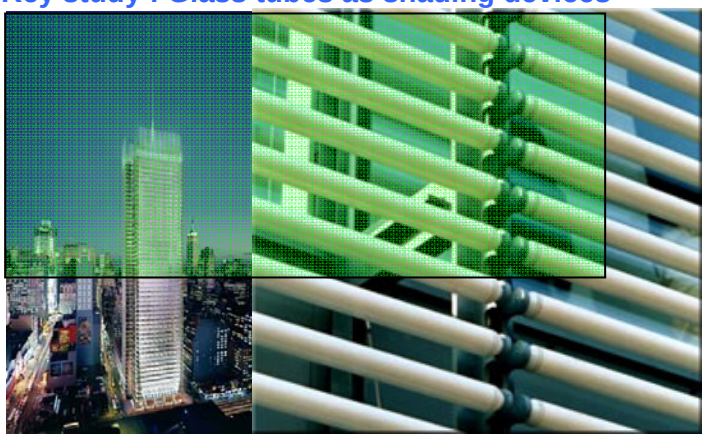
Project Description

Goal: Using a natural organism (e.g. green algae) for the generation of hydrogen on surfaces and producing energy.
The added bonus of using algae in this way is that they could consume Carbon Dioxide (CO_2) in the atmosphere and thus possibly slow down Global Warming. Developing a hydrogen cells with an economically viable 10 percent efficiency level. This can be achieved by shortening the chlorophyll stacks in the photosynthetic organelles.

Issues and Approaches: The focus will be on successful application of organisms on surfaces and the capturing of hydrogen.

Key study : Glass tubes as shading devices



Hydrogen cells can be incorporated into the façade of a building, complementing or replacing traditional materials like roofing tiles, batten-seam metal roofing component ore semi-transparent glazing. Often, these installations are vertical, reducing access to available solar resources, but the large surface area of buildings can help compensate for the reduced power output.
A possible application for a hydrogen facade in buildings can be algae's filled glass tubes fully integrated in glazed curtain wall. Low-emissive glass screened by algae's filled glass tubes will reduce the building's cooling loads and produce at the same time hydrogen as an energy resource. Thin horizontal glass tubes placed on a steel framework in front of the glass will screen and shade the full-height glass wall around the building and diffuses light through them from different angles. The produced hydrogen can be coupled with a fuel cell to generate heating or cooling energy for the building.

This energy peak-shaving value of a hydrogen facade

The cost of peak electric power for the top 50-150 hours a year is $600-900/MWh, typically 30-40 times the cost of base load power (~$20/MWh). The hydrogen facade will provides energy for peak capacity. Using hydrogen for peak storage will be worthwhile, particularly in cities with transmission constraints (such as Los Angeles, San Francisco, Chicago, New York City, and Long Island). Globally the Hydrogen storage can also save power-plant fuel by permitting more flexible operation of the utility system..

Critical Tasks

- *Application of organisms on surfaces*
- *Testing environmental resistance of surface structure and organisms*
- *Developing understanding of interaction with substrate*
- *Developing capturing techniques*

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