

Tobacco plants tapped to grow solar cells

Engineered virus injected in plants can produce alternative energy

Eric Bland, Discovery Channel, 1-25-10

Tobacco plants could help wean the world from fossil fuels, according to scientists from the University of California, Berkeley.

In a paper in the journal ACS Nano Letters, Matt Francis and his colleagues used tobacco plants, infected with a genetically engineered virus, to produce artificial photovoltaic and photochemical cells. The technique is more environmentally friendly than traditional methods of making solar cells and could lead to cheap, temporary and biodegradable solar cells.

"Over billions of years, evolution has established exactly the right distances to collect light from the sun and to do so with unparalleled efficiency," said Francis. "We are just trying to mimic these finely tuned systems."

Synthetic solar cells don't just grow on tobacco plants. They have to be programmed to grow on tobacco plants. Reprogramming every cell of a mature tobacco plant would be a massive undertaking for human scientists.

For the tobacco mosaic virus, however, reprogramming adult tobacco cells to produce tiny structures the plant normally would not make is what the virus does best. The scientists tweak a few genes in the virus, spray it over a crop of tobacco plants, and wait.

Usually, an infected cell creates new copies of the virus that infected it. This time, the virus forces the plant to create artificial chromophores, structures that turn light into high powered electrons.

Like a tightly coiled spiral staircase, individual chromophores are added one at a time until a rod hundreds of nanometers long is created. Each chromophore is two to three nanometers away from their nearest neighbor, an important distance. Even one atom closer to each other, and an electric current would be halted. Any further and harvesting the electrons would be difficult.

"It's very difficult to recreate photosynthesis," said Angela Belcher, a researcher at MIT who uses viruses to build batteries and other structures. "The precision of each structure is very important, and it's very hard to pick up one molecule and put it where you want it to be."

The beauty of the Nano Letters paper, says Belcher, is that it exploits an already efficient system, honed by millions of years of evolution, to produce structures for humans.

Trapped inside the plant, the tiny structures don't produce electricity or chemicals. To get at the synthetic chromophores, scientists harvest the plants, chop them up and extract the structures. Dissolved in a liquid solution, the structures are sprayed over a glass or plastic substrate coated with molecules that secure the rods to the plastic.

Tobacco plants aren't the only organisms Francis and his colleagues have hacked. Skipping a virus entirely, Francis and his colleagues successfully added the chromophore-producing genes to E. coli bacteria, and harvested solar cells from them as well.

Using live organisms to create synthetic solar cells has several advantages over traditionally made solar panels.

No environmentally toxic chemicals are required to make biologically derived solar cells, unlike traditional solar cells. Growing solar cells in tobacco plants could put farmers back to work harvesting an annual crop of solar cells.

Bio-based solar cells wouldn't last as long as the average silicon solar cell, but they could act as a cheap, transportable, and temporary biodegradable power source. A solution of them could even be sprayed over plastic or glass to harvest energy.

Plants are already very efficient at turning the sunlight into sugar and other forms of chemical energy. The UCB scientists could eventually use the electrons to generate chemical energy like plants, but instead of creating sugar, they would create hydrocarbons that could power cars or aircraft. A photochemical cell is one use for the new technology. A photovoltaic cell, that converts sunlight into electricity, is another possibility.

It will likely be years before any consumer devices use the natural, yet synthetic, solar cells, says Francis. The scientists haven't even demonstrated that the cells can turn light into electrical or chemical energy yet. But they hope to do soon.