

Solutions for a Sustainable Future

Solar Leaf: Dear Mr. Comfort: I overheard someone talking about an Artificial Solar Leaf last week that produces power. Does such a thing exist.



The natural photosynthetic apparatus is a remarkable machine, but plants and photosynthetic microbes were not designed to meet human energy needs - much of the energy captured from the sun is necessarily devoted to the life processes of the plants. Imagine the potential energy benefits if we could generate fuels directly from sunlight, carbon dioxide, and water in a manner analogous to the natural system, but without the need to maintain life processes. The impact of replacing fossil fuels with fuels generated directly by sunlight would be immediate and revolutionary.

The artificial leaf has been a target of solar research for years — an object that creates fuel sources out of sunlight, mimicking photosynthesis. But this solar energy breakthrough has always been thwarted by the need for rare components until now. Scientists have been working on this for a long time already, and no laws of thermodynamics are being broken. In fact systems that used sunlight, a catalyst and a small amount of electric current could already be used to split water into hydrogen efficiently with the almost all the energy needed coming from the sun. The main problem has always been the expensive and/or rare elements needed in the catalysts. The catalysts aren't used up in the process but if you want to run a large scale energy system on this technology a huge amount of catalyst is needed. Fix that and you have cheap energy from sunlight, that you can store cost effectively for use at night or a rainy day.

Factoid: A recent breakthrough was the recent discovery at M.I.T. of several powerful new, inexpensive catalysts, made of nickel and cobalt, that are capable of efficiently splitting water into its two components, hydrogen and oxygen, under

simple conditions. Right now, the artificial leaf is about 10 times more efficient at carrying out photosynthesis than a natural leaf

An actual working “artificial leaf” is not a new concept. The first artificial leaf was developed more than a decade ago by John Turner of the U.S. National Renewable Energy Laboratory in Golden, Colorado. Although highly efficient at carrying out photosynthesis, Turner’s device was impractical for wider use, as it was composed of rare, expensive metals and was highly unstable — with a lifespan of barely one day.

M.I.T.’s new leaf overcomes these problems. It is made of inexpensive materials that are widely available, works under simple conditions and is highly stable. In laboratory studies, he showed that an artificial leaf prototype could operate continuously for at least 45 hours without a drop in activity.

The device bears no resemblance to Mother Nature’s counterparts in nature, which has been the model used by scientists for their efforts to develop this new genre of solar cells. M.I.T.’s solar leaf is about the shape of a poker card but thinner, the device is fashioned from silicon, electronics and catalysts, substances that accelerate chemical reactions that otherwise would not occur, or would run slowly. Placed in a single gallon of water in a bright sunlight, the device could produce enough electricity to supply a house in a developing country with electricity for a day. It does so by splitting water into its two components, hydrogen and oxygen.

The hydrogen and oxygen gases would be stored in a fuel cell, which uses those two materials to produce electricity, located either on top of the house or beside it.

Factoid: The idea is to have the combination of solar “leaf” and fuel cell as an affordable onsite renewable energy appliance that practically anyone could afford, just like a furnace (my favorite of course), hot water heater or emergency generator.



Though M.I.T. is apparently the first to come up with a commercially viable, low-cost renewable energy system based on photosynthesis, other researchers are also following the trail. At the Department of Energy a long-running research into a light-harvesting protein from spinach has resulted in a similar hydrogen-producing process. They describe their latest breakthrough as a biohybrid photoconversion system. The researchers were able to confirm that a particular light-harvesting protein derived from everyday supermarket spinach can be induced to assemble itself into a membrane, by putting it into a liquid solution containing synthetic polymers. The protein, called LHC-II (LHC stands for Light Harvesting Complex) interacts with the polymers to form a membrane, which in turn produces hydrogen. In other words the membrane acts as a kind of photovoltaic cell, but instead of generating electricity, it generates hydrogen.

I am Jim Steigner (Mr. Comfort), and I just wanted you to know. As always please feel free to contact me at www.mrcomforthvac.com, under the “Ask Mr. Comfort” Section.