Spinach. It saved Popeye, now it could save the world.

Bio-Solar Energy Nanodevices
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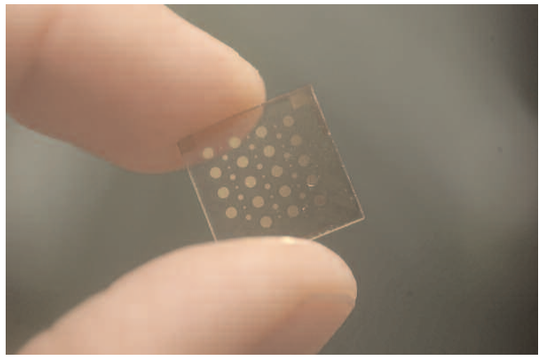
Mobile communication and portable computing devices call for a continuous, self-sustained energy source, but present technology lags behind this need.

However, PhDs Shuguang Zhang and Marco Baldo at the Massachusetts Institute of Technology are collaborating with others on an idea that could solve this problem and ultimately revolutionize the way we generate energy on Earth.

Their Bio-Solar Energy Nanodevices go back to nature, to the process of photosynthesis. In the simplest terms, they are solar cells that use plant protein, spinach (although other green plant and algae material is viable) to convert sunlight directly into electrical energy.



Five trillion Nanodevices can be packed on to a single square centimetre surface.

Almost all energy on Earth is obtained from photosynthesis through trees, green plants, and photosynthetic bacteria and algae. The fossil fuel and coal we use today comes from solar energy stored in them millions of years ago.

There are two plant photosynthesis systems, Photosystem I and Photosystem II, and they are the most efficient energy-harvesting systems there are. PS-II also produces hydrogen from water at the same time. Harnessing the energy and hydrogen, these systems produce could provide us with clean and near-inexhaustible energy.

How does the Bio-Solar Energy Nanodevice work? As a first step, the developers used the simpler PS-I system.

The raw material is available at any supermarket of course, and it's purified to create the PS-I. The individual PS-I nanodevice is only around 20 nanometers in size, so five trillion can be packed on to a single square centimetre, two-dimensional surface area.

The purified spinach (the protein) has to be stabilized on to gold surfaces. This is achieved by using novel molecular-designed peptide detergents discovered by Shuguang Zhang. They act as artificial membranes to stabilize the finicky protein complexes, and they effectively preserve the integrity of the PS-I complex in dry form for over 500 hours (three weeks).

The peptide detergent PS-I complex system produces not only electric current but also electric voltage.

By definition, the components of nanotechnology are 100,000 times thinner than a human hair, but these Bio-Solar Energy Nanodevices could be the start of something very big in the harvesting of energy.

Peptides? Detergents? There's a basic set of molecular building blocks in nature. This includes 20 amino acids, a few nucleotides (the structural units of nuclear acids such as RNA and DNA), around a dozen lipid molecules, and two dozen sugars.

Biotechnologists have learned how to manipulate these building blocks. Using amino acids, for example, to create peptides.

These peptides are molecular architectural units. In water and in body fluids, they form well-ordered nanofibre scaffolds useful for growing three-dimensional tissue and for regenerative medicine.

All biomolecules, including peptides, naturally interact and self-organize to form well-defined structures.

The peptide detergents discovered by Shuguang Zhang probably work (in a similar way to other detergents) by surrounding parts of the spinach in the nanodevice and preventing them from interacting with water molecules. By doing this, the detergents maintain the overall structural integrity of the PS-I complex and retain its biological function.

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