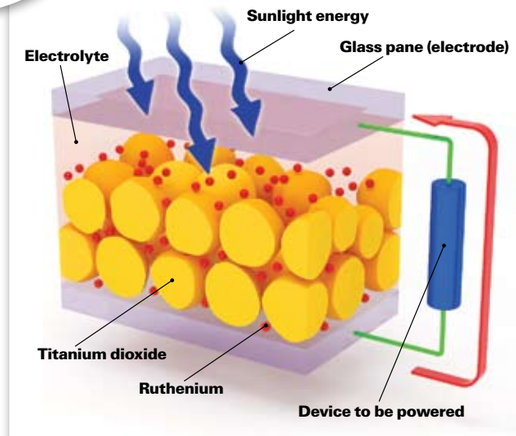
The Business of Biomimicry

BY JANINE M. BENYUS AND GUNTER PAULI Biomimics draw inspiration for new product designs from biological processes, physical traits, and behavioral strategies observed in nature. The classic example of biomimicry innovation is Velcro, whose inventor, George de Mestral, observed that the hooked tips of thistle seeds caused them to stick to the fur of his dog. Today we look ever more systematically to nature for sustainable solutions to a host of practical problems – whose existing solutions are often environmentally unfriendly or energy inefficient. We believe that now is an opportune time for global businesses to develop profitably around some of the ideas nature offers. One innovation – dye-sensitized solar cells (DSSC) – presents an interesting example of the business potential of biomimicry.

Velcro magnified

The Biological Model

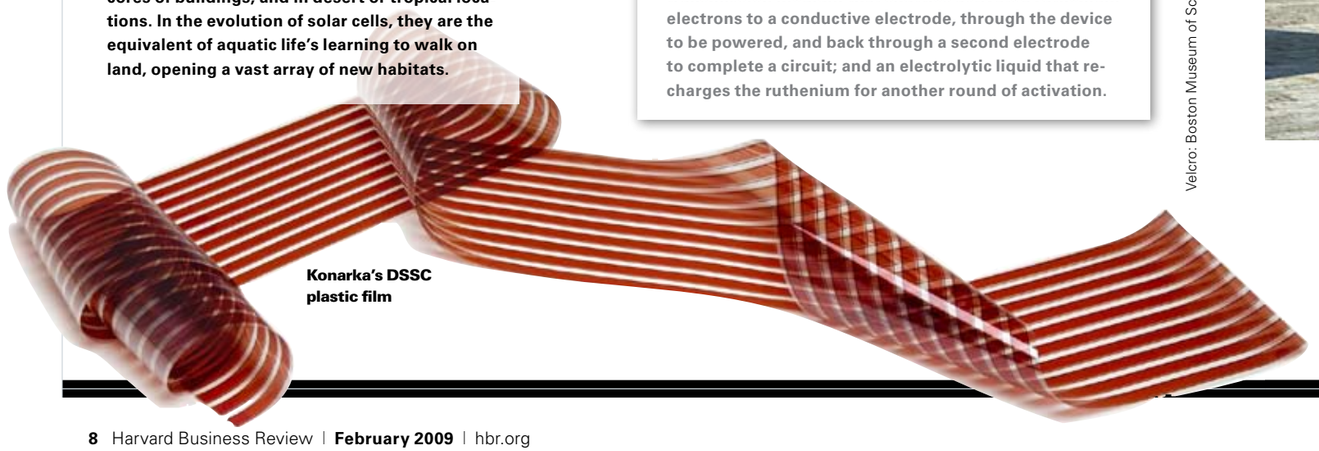
What was needed was something as self-reliant and elegantly capable as a leaf. Emulation of plant photosynthesis led to the development of dye-sensitized solar cells.



Between two panes of glass the scientists Michael Grätzel and Brian O'Regan combined ruthenium, a metal dye (equivalent to the green leaf pigment chlorophyll) whose electrons are activated by sunlight; titanium dioxide, a transmission medium that shuttles activated ruthenium electrons to a conductive electrode, through the device to be powered, and back through a second electrode to complete a circuit; and an electrolytic liquid that recharges the ruthenium for another round of activation.

The DSSC Advantage

DSSC materials can collect light at shallow angles, capture dim as well as full sun, and work in scorching temperatures (all of which bedevil traditional photovoltaics). They can go where silicon panels can't: on vertical surfaces, in the shaded lower "canopy" of cities, in the sunless cores of buildings, and in desert or tropical locations. In the evolution of solar cells, they are the equivalent of aquatic life's learning to walk on land, opening a vast array of new habitats.



Konarka's DSSC plastic film

Velcro: Boston Museum of Science; Plant photo: Tina Fuller; Digital renderings: MDI Digital

DSSC technology applied to a tent

Expanding the Solar-Cell Market

Although DSSCs are currently less efficient than traditional PV cells, they're 60% cheaper to produce and more versatile – they can be made into flexible films or fibers in a process similar to ink-jet printing. Two companies – Konarka, of Lowell, Massachusetts, and Dyesol, of New South Wales, Australia – stand out for having pioneered advances in DSSC materials and manufacturing technologies that lower costs and improve performance.

One Promising Solution

Inexpensive, nontoxic solar harvesters can work not only on roofs but also on vertical, curved, shaded, or even indoor surfaces. Millions of distributed harvesters could be networked on a neighborhood scale or used alone when grids failed. Steel makers are already testing ways of incorporating DSSC into structural steel. Imagine the Golden Gate Bridge doubling as a power plant.

An Assault on Batteries

At present, DSSC can't claim to compete with the traditional electric grid. But as a power source for small appliances, toys, flashlights, and other devices, the technology is an economical alternative to batteries—which are 100 times as expensive per kilowatt hour as power from the grid and become highly polluting once discarded.