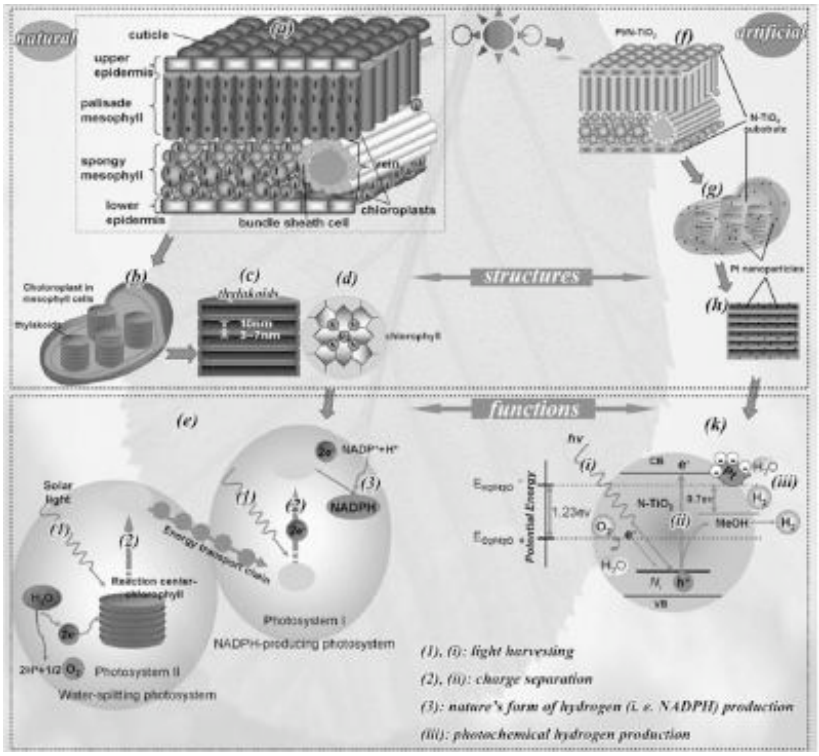
"Artificial leaves" could help power machines of future

March 26, 2010
Courtesy of the American Chemical Society
and World Science staff

Scientists are presenting a design strategy for a long-sought artificial leaf, which they say could harness Mother Nature's ability to produce energy from sunlight and water.

The blueprint, based on the chemistry and biology of leaves, could lead to working prototypes of an artificial leaf that capture solar energy and use it efficiently to change water into hydrogen fuel, the researchers said.



Part of the recipe for an artificial leaf (Credit: Tongxiang Fan)

Using sunlight to split water into its components, hydrogen and oxygen, is one of the most promising and sustainable tactics to escape current dependence on coal, oil, and other traditional fuels, said researcher Tongxiang Fan of Shanghai Jiaotong University in China.

When burned, those fuels release carbon dioxide, the main "greenhouse gas" blamed for global warming because of its heat-trapping effects in the atmosphere.

Burning hydrogen, in contrast, forms just water vapor. That appeal is central to the much-discussed "hydrogen economy"; some auto companies have developed hydrogen-fueled cars. Lacking, however, is a cost-effective sustainable way to produce hydrogen.

Fan and colleagues decided to take a closer look at leaves, which harvest energy from light extremely efficiently in a process called photosynthesis. Leaves contain structures responsible for focusing and guiding solar energy into their light-harvesting areas. The scientists opted to mimic that design in a blueprint that incorporates the compound titanium dioxide, already recognized as a "photo-catalyst" for hydrogen—a chemical stimulator of hydrogen production from light.

In a two-step process, the scientists infiltrated leaves of the Chinese plant *Anemone vitifolia* with titanium dioxide to create a new, artificial structure based on that compound. They found that the structural features in the leaf favorable for light harvesting were replicated in the new structure, which was measured to be three times as active for hydrogen production as commercial photo-catalysts.

Next, the investigators embedded sub-microscopic particles of platinum into the leaf surface. This helped boost the activity of the artificial leaves by an additional factor of ten, they said. "Nature still has much to teach us, and human ingenuity can modify the principles of natural systems for enhanced utility," Fan declared. The findings were presented March 25 at the National Meeting of the American Chemical Society in San Francisco.