Higher efficiency organic solar cell created

July 12 2007

Using plastics to harvest the energy of the sun just got a significant boost in efficiency thanks to a discovery made at the Center for Polymers and Organic Solids at the University of California, Santa Barbara.

Nobel laureate Alan Heeger, professor of physics at UC Santa Barbara, worked with Kwanghee Lee of Korea and a team of other scientists to create a new “tandem” organic solar cell with increased efficiency. The discovery, explained in the July 13 issue of the journal *Science*, marks a step forward in materials science.

Tandem cells are comprised of two multilayered parts that work together to gather a wider range of the spectrum of solar radiation — at both shorter and longer wavelengths. “The result is six and a half percent efficiency,” said Heeger. “This is the highest level achieved for solar cells made from organic materials. I am confident that we can make additional improvements that will yield efficiencies sufficiently high for commercial products.” He expects this technology to be on the market in about three years.

Heeger and Lee have collaborated for many years on developing solar cells. The new tandem architecture that they discovered both improves light harvesting and promises to be less expensive to produce. In their paper, the authors explain that the cells “… can be fabricated to extend over large areas by means of low-cost printing and coating technologies that can simultaneously pattern the active materials on lightweight flexible substrates.”

The multilayered device is the equivalent of two cells in series, said Heeger. The deposition of each layer of the multilayer structure by processing the materials from solution is what promises to make the solar cells less expensive to produce.

“Tandem solar cells, in which two solar cells with different absorption characteristics are linked to use a wider range of the solar spectrum, were fabricated with each layer processed from solution with the use of bulk heterojunction materials comprising semiconducting polymers and fullerene derivatives,” wrote the authors.

The cells are separated and connected by the material TiO_x, a transparent titanium oxide. This is the key to the multilayer system that allows for the higher-level efficiencies. TiO_x transports electrons and is a collecting layer for the first cell. In addition, it acts as a stable foundation that allows the fabrication of the second cell, thus completing the tandem cell architecture.

Heeger shared the Nobel Prize in Chemistry in the year 2000, with Alan MacDiarmid and Hideki Shirakawa, for the “discovery and development of conducting polymers.” The tandem solar cells reported in the Science article utilize semiconducting polymers from the class of materials that were recognized by the award of the Nobel Prize.

With Howard Berke, Heeger in 2000 co-founded Konarka Technologies, based in Lowell, Mass., to develop and market solar cells based on this technology.

Heeger recently was presented with the Italian Prize for Energy and the Environment (Eni Italgas Prize) for his discoveries and research accomplishments in the field of “plastic” solar cells. The Italian agency cited Heeger “for research that will begin to contribute to the energy needs of our planet in the near future.”

An exciting aspect of the latest discovery is that it is expected to contribute to third world usage of technologies such as laptop computers in areas that are “off the electricity grid.”

Source: University of California - Santa Barbara