Renewable energies : the promise of organic solar cells

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(PhysOrg.com) -- In the race to renewable energy, organic solar cells are now really starting to take off. They can be manufactured easily and cheaply, they have low environmental impact, and since they are compatible with flexible substrates, they could be used in many applications such as packaging, clothing, flexible screens, or for recharging cell phones and laptops.

Teams at the Université d'Angers and at the Université Strasbourg have recently obtained record conversion efficiency with solar cells based on organic molecules. Their work has been published online on the web site of the *Journal of Materials Chemistry*.

Photovoltaic solar energy works by transforming a fraction of solar radiation into electricity by means of solar cells, which are connected together to form a photovoltaic solar cell module. The solar cells currently on the market are made up of inorganic materials such as silicon.

A great deal of international research is aimed at developing solar cells made up of organic (carbon-compound based) semiconductors. Although their performance is still considerably lower than that of cells based on crystalline silicon (around 5% efficiency as compared with 15% for silicon cells), they present numerous advantages. Unlike crystalline silicon, which has to be produced at very high temperatures, they can be manufactured cheaply with low energy cost and environmental impact, arguments which are by no means insignificant when it comes to

renewable energy.

Moreover, the fact that they are made using solution processes (for instance from inks or paints) makes it possible to cover large areas and flexible substrates such as films and fabrics.

Organic solar cells are not intended to compete with silicon, but rather to be used for specific applications, such as packaging, clothing, flexible screens, and recharging cell phones and laptops. However, in the longer term, they could make a significant contribution to the photovoltaic conversion of solar energy, as long as there is major investment in research into new, more efficient and stable materials.

Over the past ten years or so, most research has focused on developing organic cells in which the active light-absorbing material is made up of long conjugated polymer chains. Although these cells are the most efficient yet discovered, the use of polymers poses a certain number of problems: synthesis, purification, control of the molecular structure and mass, and the distribution of different lengths of chain (polydispersity).

In order to overcome these obstacles, Jean Roncali's team of researchers at the Université d'Angers has developed a novel approach based on replacing polymers by conjugated molecules with a clearly defined structure. Whereas the conversion efficiencies of the initial prototypes published in 2005 were of the order of 0.20%, a collaboration between the Angers team and Raymond Ziessel's team at the Université Strasbourg, supported by CNRS's Energy program, has recently succeeded in reaching conversion efficiencies of 1.70%, which are among the highest known for this type of cell until now.

New classes of active material specifically adapted to such cells are currently being synthesized in these laboratories. In this way, the researchers are hoping to improve their results very rapidly. Industry will

no doubt be keeping close watch on their progress.

More information:

Multi-donor Molecular Bulk Heterojunction Solar Cells: Improving Conversion Efficiency by Synergistic Dye Combinations. Theodulf Rousseau, Antonio Cravino, Thomas Bura, Gilles Ulrich, Raymond Ziessel and Jean Roncali. *Journal of Materials Chemistry*. In press, available online.

Bodipy Derivatives as Donor Materials for Bulk Heterojunction Solar Cells. Theodulf Rousseau, Antonio Cravino, Thomas Bura, Gilles Ulrich, Raymond Ziessel and Jean Roncali. *Chemical Communication*, 19 March 2009.

Provided by CNRS

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