Improving the efficiency of solar energy cells

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University of Adelaide chemistry researchers are studying energy loss at the molecular level of new 'plastic' materials as a step towards the development of highly efficient, low-cost and flexible solar energy cells.

One aim is to be able to "tune" the molecules to make them more energy efficient, thereby reducing energy loss, and able to harvest more photons from the sun.

They hope one day this research could lead to applications such as whole buildings being covered with a semi-transparent, flexible window tint that would act as a giant solar cell, trapping energy from the sun and generating electricity to power the building.

"Traditional solar cells used in the solar panels we have on our roof-tops are made from silicon which require a large amount of energy to produce and are expensive," says Patrick Tapping, PhD candidate in the School of Physical Sciences.

"There is a whole category of new 'plastic' materials, called organic semi-conductors and, like normal plastics, they are made from hydrocarbon chains or polymers. But unlike normal plastics, they can conduct electricity.

"These materials are flexible and cheap to manufacture – they can be printed out as giant sheets. But at the moment they are not currently very good at turning absorbed light into harvestable electricity. They don't transport electrons to electrodes as efficiently as they should.

"Our research is giving us a better understanding of how these materials behave at molecular level."

The researchers in the University's Department of Chemistry — including Mr Tapping and his supervisors Dr Tak Kee and Dr David Huang — are using ultra-fast laser spectroscopy and computer modelling to "watch" the reactions occurring inside the polymer-based solar cells.

Spectroscopy allows the study of matter via its interaction with light. Ultra-fast laser spectroscopy uses extremely short pulses of light, measuring the interactions at the molecular level with an electronic detector.

"We're conducting experiments and using computer simulations to look at the arrangements of the polymer chains to see how they affect the electricity-generating properties of the materials," says Mr Tapping.

"By the speed and intensity of the changes to light-absorption, we can gain insight to where potential sources of energy loss may be occurring. This can then guide changes in order to better harvest the sun for more efficient energy generation."

Provided by University of Adelaide

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