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PRESS RELEASE

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IMPORTANT DEVELOPMENTS IN THE FIELD OF ORGANIC PHOTOVOLTAICS FROM RESEARCHERS AT THE DEPARTMENT OF CHEMISTRY OF THE UNIVERSITY OF CYPRUS

Deeper understanding of the function of the most efficient “plastic” solar cells

Scientists don't fully understand how 'plastic' solar panels work, which complicates the improvement of their cost efficiency, thereby blocking the wider use of the technology. However, Assistant Professor Sophia Charalambous Hayes of the Dept. of Chemistry of the University of Cyprus led a key study to determine how light beams excite the chemicals in solar panels, enabling them to produce charge. The study used new technology at the Central Laser Facility (CLF) at the Rutherford Appleton Laboratory, UK, after receiving funding from the FP7 European research program LASERLAB-EUROPE and the Science and Technology Facilities Council, UK. This was an international collaboration between the University of Cyprus, the University of Montreal (Françoise Provencher, Carlos Silva, Nicola Bérubé και Michel Côté), CLF (Tony Parker, Greg Greetham και Mike Towrie) and Imperial College, London (Christoph Hellmann και Natalie Stingelin).

The researchers have been investigating the fundamental beginnings of the reactions that take place that underpin solar energy conversion devices, studying the new brand of photovoltaic diodes that are based on blends of polymeric semiconductors and fullerene derivatives. In these devices, the absorption of light fuels the formation of an electron and a positive charged species. To ultimately provide electricity, these two attractive species must separate and the electron must move away. If the electron is not able to move away fast enough then the positive and negative charges simply recombine and effectively nothing changes. The overall efficiency of solar devices compares how much recombines and how much separates.

Two major findings resulted from the team's work with the use of the advanced ultrafast laser technique "Femtosecond stimulated Raman spectroscopy.” The particular technique provides details on how chemical bonds change during extremely fast chemical reactions. The laser provides information on the vibration of the molecules as they interact with the pulses of laser light. Extremely complicated calculations on these vibrations enabled the scientists to ascertain how the molecules were evolving. Firstly, they found that after the electron moves away from the positive centre, the rapid molecular rearrangement must be prompt and resemble the final products within around 300 femtoseconds (0.0000000000003 s). A femtosecond is a quadrillionth of a second – a femtosecond is to a second as a second is to 3.7 million years. This promptness and speed enhances and helps maintain charge separation. Secondly, the researchers noted that any ongoing relaxation and molecular reorganisation processes following this initial charge separation, as visualised using the FSRS method, should be extremely small. These findings open avenues for future research into understanding the differences between material systems that actually produce efficient solar cells and systems that should be as efficient but in fact do not perform as well. A greater understanding of what works and what doesn't will obviously enable better solar panels to be designed in the future.

The article "Direct observation of ultrafast long-range charge separation at polymer–fullerene heterojunctions," was published in the scientific journal *Nature Communications* on the 1st of July, 2014.

End of Announcement