Solar Energy Conversion
SFI Strategic Research Cluster

science foundation ireland
fondúireacht eolaíochta éireann

presents a **Half-Day Symposium** on

Solar Energy Conversion Technologies

Tuesday 14th October 2008 at 2.30pm

Room 121
UCD Engineering & Materials Science Centre
UCD Dublin, Belfield D4

This Symposium is open to all interested parties

2.30pm **Current Interests in Solar Cell Technologies at the Tyndall National Institute**
Professor Martyn E Pemble
Head, Advanced Materials and Surfaces Group
Tyndall National Institute, University College Cork

3.15pm **Nanostructured and Molecular Materials for Photovoltaic Energy Conversion**
Professor Jenny Nelson
Professor of Physics, Natural Sciences, Imperial College London

4.15pm **Photocatalytic Processes for Sustainable Energy Sources**
Professor Johannes G. Vos
SRC for Solar Energy Conversion, School of Chemical Sciences, Dublin City University

5.00pm **Harnessing Solar Energy Economically**
Professor Brian Norton
Dublin Energy Lab, Dublin Institute of Technology

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Current Interests in Solar Cell Technologies at the Tyndall National Institute

Professor Martyn E Pemble
Head, Advanced Materials and Surfaces Group
Tyndall National Institute, University College Cork

This talk will focus on the range of activities that are currently underway at the Tyndall National Institute in Cork in the area of solar cell technology including the use of nanoparticle thin film absorber systems, the development and growth of new or improved transparent conducting oxides, the study and optimization of interfaces between metal electrodes and dielectrics and the use of colloidal photonic crystals for enhanced light capture and harvesting. Under this latter heading the topic of novel solar cell architectures will be presented based on the assembly of colloidal photonic crystals coupled with the use of atomic layer deposition and chemical vapour deposition methods for the direct fabrication of, for example, dye-loaded TiO_2 nanoparticles, or crystalline silicon nanoparticles embedded within the colloidal structure.

Nanostructured and Molecular Materials for Photovoltaic Energy Conversion

Professor Jenny Nelson
Imperial College London

In order for photovoltaic (PV) electricity to help meet the rising demand for non-fossil power sources, substantial reductions in the cost per peak Watt are required. One route to lower cost photovoltaic power is the use of plastic solar cells made from thin films of solution processible organic semiconductors. Because of the molecular nature of the materials, efficient conversion of solar photons into charge pairs requires intimate mixing of two different semiconducting materials, typically a conjugated polymer combined with a second molecular material or inorganic semiconductor nanocrystals. For optimum performance the two components should be phase-separated on a length scale on the order of ten nanometers whilst each phase should be sufficiently ordered to provide a low resistance charge pathway to the electrodes. To achieve this optimum morphology, materials with self-organising properties are used such as crystalline or liquid crystalline conjugated polymers, arrays of nanocrystals or oriented nano-rods, and self-assembling small molecules. Achieving high power conversion efficiencies with such self-assembling heterojunctions requires control over the morphology of the binary structures formed, and understanding of the processes of energy and charge transport within the heterogeneous, nanostructured environment. We will report on experimental studies of the factors controlling charge separation and photocurrent generation in such heterojunctions, and will present results demonstrating the influence of blend morphology on photovoltaic performance.

Photocatalytic Processes for Sustainable Energy Sources

Professor Johannes G. Vos
SRC for Solar Energy Conversion, School of Chemical Sciences, Dublin City University

Global climate change and security of energy supply are increasingly perceived as the most serious threats facing the world's medium and long-term future. There is therefore a clear need for the development of new technologies leading to novel sustainable energy sources. The utilisation of solar energy is high on the agenda and considering that the amount of solar energy hitting the earth every hour, is equivalent to the energy needed on the earth for a whole year, this seems an approach well worth pursuing. In this presentation a new environmentally friendly approach of using sunlight for the production of useful fuels is outlined. A hydrogen-based economy is widely seen as an ideal solution to environmental problems, however, at present no sustainable methods exist for hydrogen production. In this presentation the development of a novel solar cell for the generation of H_2 from water is outlined. The system to be developed will produce hydrogen from sunlight and water. In the approach taken semiconductors will be coated with metal compounds and the photocatalytic properties of these assemblies with respect to the generation of hydrogen from water will be investigated. The molecular components will consist of compounds containing a light-absorbing unit connected via a bridging ligand to a catalytic centre capable of producing hydrogen. This approach will not only reduce our need for fossil fuels but also contribute to reduced CO_2 emissions. Photocatalytic processes capable of reducing CO_2 to useful fuels will also be discussed.

Harnessing Solar Energy Economically

Professor Brian Norton
Dublin Energy Lab, Dublin Institute of Technology

Through its "Dublin Energy Lab", Dublin Institute of Technology (DIT) has become recognised internationally via award-winning publications reporting research across a wide-range of solar energy technologies and their applications. This presentation will discuss the climatic contexts and economic imperatives for this research and illustrate some particular discoveries innovations and insights. These include the first use of phase change materials for the thermal management of photovoltaics, the development of novel solar-cell-antennae, the establishment of coherent design methodologies for PV systems and extensive analysis of long-term PV system performance both in building integrated applications and in stand-alone uses such as water pumps in Jordan. Extensive research has been undertaken on luminescent concentrators as well as non-imaging optical convertators. An overview will also be provided of DIT's research on the development of new solar thermal devices and the geographic variation of their performance.