the INSTITUTE for ENERGY EFFICIENCY

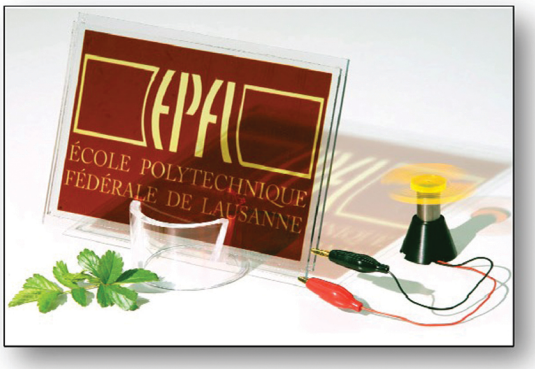
SEMINAR

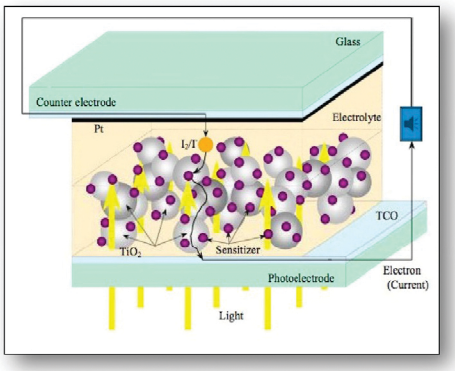
Friday, March 19, 2010
3:00pm/Refreshments at 2:45pm
Marine Science Research Building (Marine Science Institute)
Auditorium (room 1302)

ICB

Professor Michael Graetzel

Director, Laboratory of Photonics and Interfaces
Ecole Polytechnique Fédérale, Lausanne





Molecular Photovoltaics and Mesoscopic Solar Cells

The field of photovoltaic cells has been dominated so far by solid state p-n junction devices made of crystalline or amorphous silicon, CdTe and copper indium gallium diselenide (CIGS) profiting from the experience and material availability of the semiconductor industry. However, there is an increasing awareness of the possible advantages of devices based on mesoscopic inorganic or organic semiconductors commonly referred to as "bulk" junctions due to their interconnected three-dimensional structure. It is now possible to depart completely from the classical solid-state cells, replacing them by devices based on interpenetrating network junctions. The mesoscopic morphology produces an interface with a huge area endowing these systems with intriguing optoelectronic properties. These cells are formed, for example, from nanocrystalline inorganic oxides, ionic liquids and organic hole conductor or conducting polymer devices, which offer the prospect of very low cost fabrication without expensive and energy intensive high temperature and high vacuum processes. They can feasibly be produced employing flexible substrates and are compatible with a variety of embodiments and appearances to facilitate market entry, both for use in domestic devices as well as in architectural or decorative applications. The prototype of this new PV family is the dye-sensitized solar cell (DSC). This cell accomplishes the separation of the optical absorption and the charge separation processes by the association of a sensitizer as light-absorbing material with a wide band gap semiconductor of nanocrystalline morphology [1-3]. The DSC has made phenomenal progress since its discovery was announced in the scientific literature some 15 years ago. Present conversion efficiencies are over 12 percent for single junction and 16 percent for tandem cells. Excellent stability has been reached rendering the DSC a credible alternative to conventional p-n junction photovoltaic devices. Mesoscopic solar cells have become viable contenders for large-scale future solar energy conversion systems on the bases of cost, efficiency, stability and availability as well as environmental compatibility.