The Centre for Hybrid and Organic Solar Energy (CHOSE) is located in the University of Rome "Tor Vergata" and in the high-tech campus of TecnoPolo Tiburtino, where many technology companies of the Rome area are based. CHOSE has built a national network by setting up collaborations with many of the research institutions active in the field of DSCs in Italy. These include the universities of Ferrara, Turin, Pavia, Rome "La Sapienza", CNR and some industrial companies.
CHOSE laboratories locations are the following:

① the campus of Rome Tor Vergata University (administration, chemistry, outdoor measurements);

② the high-tech campus of TecnoPolo Tiburtino (main R&D facilities, pilot line).

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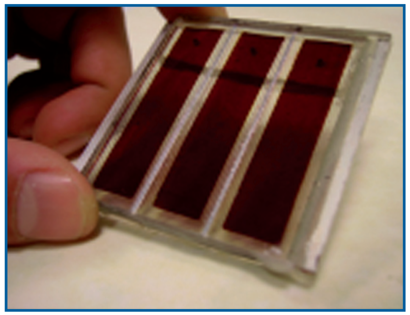
CHOSE

CENTRE FOR HYBRID AND ORGANIC SOLAR ENERGY

WORKING PRINCIPLES OF DYE SOLAR CELLS

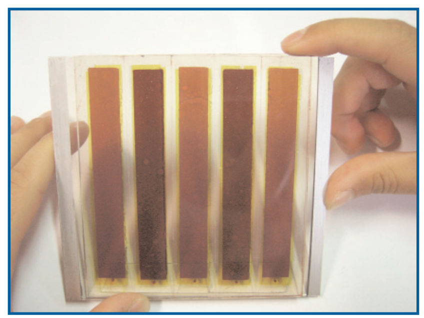
Dye solar cells (DSCs) consist typically of two conductive glass plates in which the three main active components of the cell are sandwiched: a dye that strongly absorbs light from the sun, a titanium dioxide (TiO2) layer and an electrolyte which transport the electric charges across the cell.



The dye molecules are anchored to the TiO2 layer which is deposited in such a way to form a nanostructured porous film in order to greatly increase the area onto which the dye can attach itself. Dye molecules are photo-excited by the incoming light. TiO2 conduction levels are such that the electronic charges produced by the excitation of the dye are rapidly and efficiently transferred from the dye to the TiO2 and transported to the one of the electrodes. The electrolyte, after extracting charge from the other electrode, refurnishes the dye with the electron it has just lost to the TiO2. No permanent chemical transformation occurs during this basic process. In this way, the dye solar cell manages to continually transform light from the sun into electric current and energy once a load (e.g. an electrical appliance) is applied between the two terminals.

DYE SOLAR CELL MODULES

Dye solar cell technology has great potential to deliver low-cost photovoltaic modules. The photoactive material components of the cell are attractive because they can generally be processed over large areas from liquid solution or pastes using low-cost, relatively low-temperature deposition and processing techniques. The technology permits in principle a direct up-scaling from the single cell to the module as it becomes possible to create series and parallel interconnections of cells without the need of external connections as happens in conventional crystalline semiconductor technology. Production of solar modules is essential as appliances need set voltages that cannot be met by a single cell. To avoid rapid degradation of cell performance and in order to withstand the lifetime requirements of most applications, a careful choice of combination of materials and stringent encapsulation of the photoactive materials from the environment are necessary.



One of the main objectives of C.H.O.S.E is the study and development of complete fabrication techniques at the cell and module level (see Figure) on both glass and flexible substrates. In this, C.H.O.S.E is aided by the collaborations set up with a variety of partners especially regarding the development of materials for DSCs.

THE METEREOLOGICAL STATION

To monitor outdoor conditions CHOSE has set up a solar-meteo station. This facility is able to measure the performance of the photovoltaic devices and at the same time determine the environmental conditions (eg. wind speed, temperatures) and the power density of solar radiation in its various (e.g. direct and diffuse) components to which cells and modules are exposed.

The station is active since 2003. Solar radiation and climate data have been recorded and have been analysed in order to extract the mean environmental parameters of the Tor Vergata site. These data are also useful for developing models which can estimate solar output when no measurements are available.

The station is being used to test DSCs in real outdoor conditions to monitor device response to different solar radiation and environmental conditions and also to yield data on lifetime, encapsulation, materials and fabrication technologies.