HETEROMOLMAT

5 October 2008

Publishable Executive Summary

The **HETEROMOLMAT** project is a Specific Targeted Research Project focussed on the use on nanocrystalline semiconductor materials for optoelectronic applications.

The project the Partners:

✤ Institute of Chemical Research of Catalonia (ICIQ-P1).
Project Coordinator. Groups Leader Dr. Emilio Palomares.

✤ Imperial College of London (ICL-P2)
Scientific Coordinator. Group Leaders Prof. James R. Durrant and Dr. Ramon Vilar-Compte

✤ Ecole Polytechnique Fédérale de Lausanne (EPF-P3)
Scientific Coordinator. Group Leader Prof. Michael Grätzel

✤ University of Basel (UB-P4)
Scientific Coordinator. Group Leader Prof. Edwin C. Constable

✤ University Autonoma of Madrid (UAM-P5)
Scientific Coordinator. Group Leader Prof. Tomas Torres

✤ J. Heyrovsky Institute of Physical Chemistry (JHI-P6)
Scientific Coordinator. Group Leader Prof. Ladislav Kavan

✤ Tyndall National Institute (TNI-P7)
✤Scientific Coordinator. Group Leader Dr. Daniela Iacopino

✤ Institute of Molecular Sciences-University of Valencia (ICMol-P8)
✤Scientific Coordinator. Group Leader Dr. Henk Bolink

✤ Johnson Matthey Ltd. (Industrial Partner-P9)
✤Scientific Coordinator. Group Leader Dr. Rob Potter

After the 2nd year meeting the Project has focussed on two technological targets: (a) Hybrid Light Emitting Devices and (b) Near Infra-Red light-to-energy conversion systems. However, due to the importance of the results obtained in the field of molecular sensors the partners decided also to continue the research on mercury sensing using heterosupermolecular structures.
Below is the description of the technological targets as defined in the 2nd year Report.

* **Hybrid Light Emitting Diodes**. A new device based upon interfacing light emitting polymers with nano-crystalline semiconductor nanoparticles. The advantage of these new devices is the non-use of high unstable metal cathodes such as Calcium or Barium. Instead gold or even aluminum can be used a metal contacts which enhances the device life time.

* **Light coupled Chemical Sensors for toxic substances**. Based upon the design and synthesis of molecular proves that change their optical properties upon binding of a toxic substance (i.e. Mercury ions). The molecules can be attached to the surface of mesoporous metal oxide films for deep-and-read test using non-expensive equipment.

* **Near IR light-to-energy conversion devices.** The aim of these target is to proof the possibility to achieve long-lived charge separated states on near IR dye sensitised nanocrystalline metal oxide nanoparticles. There is a growing interest focussed on harvest the sun light at wavelengths higher than 700 nm and achieve light-to-electricity conversion efficiencies higher than 3.5% .

*In the first target, Hybrid Light Emitting Diodes, at the end of the project, we have have achieved all deliverables and scientific targets . During the 2nd year, based on the work of Parter 7 (UVEG) and Partner 2 (ICL), the efficiency of the device has increase to reach the objective of 10 candela/m^2 with the help and collaboration of Partner 3 (EPFL) and partner 8 (UB).

During the last year, the research has been focussed on the target of 5V as a turn-on voltage for the device and the achievement of a stable light-emitting device under operation in air (non-encapsulated) .

This achievement will have a dramatic impact on the research area where the encapsulation process is one of the most expensive and difficult process when making organic light emitting diodes.

* Our second technological target has achieved rapidly the project objectives and has generated a wide interest. During the 2nd year of the project several partners were focussed on the study on the sensitivity of the colorimetric sensor developed by P1 as well as the possibility to miniaturize the sensor (P4). During the last year, P2 (ICL) in close collaboration with P3 (EPFL) and P1 (ICIQ) have studiend alternative dyes which, due to their supermolecular structure, can be implemented in miniaturized electrochemical devices. Moreover, P9 (JM), has carried out a careful study of the possible market applications of the mercury sensor that illustrates the wide interest for this technology as it was anticipated in the previous report.

Although the DoW only reflects the need of two final target technologies the Project Partners decided to continue the work on supermolecular sensors. The advances during the last year have allowed to found a high sensitive system that responds electrochemically to the presence of mercury ions.

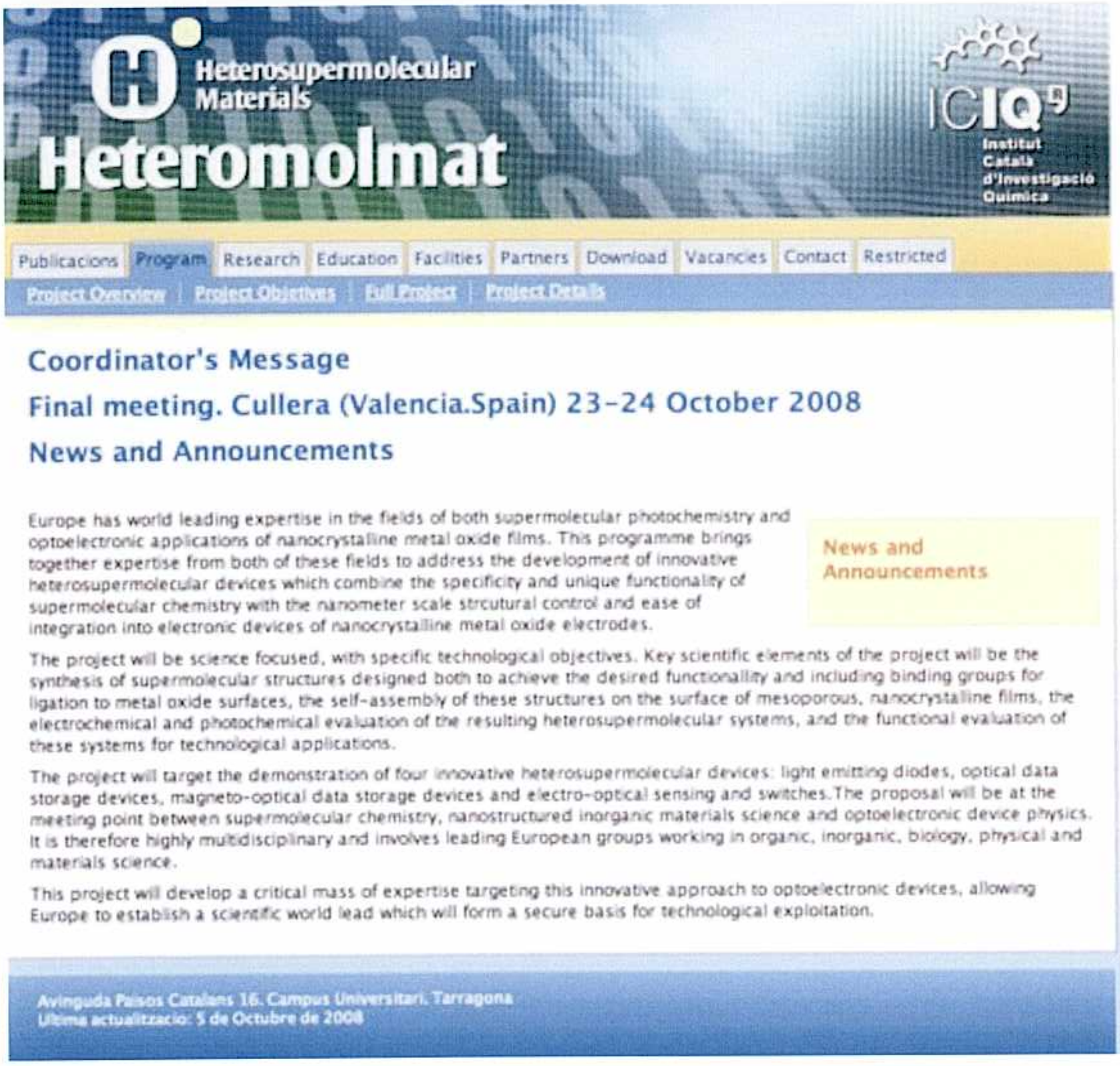
*One of the most challenging deliverables has been the synthesis of suitable near Infra-Red dyes which can convert efficiently sun light into electrical power. Usually, the sensitization of metal oxides with near IR dyes has always been synonym of inefficient devices. Based on the experience of P5 (UAM) and P4 (EPFL) in the synthesis of phthalocyanines (λabs maxima= 705 nm) and device preparation, respectively, we have achieved several world record cells.

The results obtained using near IR dyes for solar-to-energy conversion devices have opened a new way to harvest efficiently the whole solar spectrum using organic molecules.

More information about the HETEROMOLMAT project can be found at the Project Web Page.

http://www.iciq.es/Heteromolmat/index.php

Figure 1. HETEROMOLMAT web page Screen Shot.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Coordinator's Message

Final meeting. Cullera (Valencia.Spain) 23-24 October 2008

News and Announcements

Europe has world leading expertise in the fields of both supermolecular photochemistry and optoelectronic applications of nanocrystalline metal oxide films. This programme brings together expertise from both of these fields to address the development of innovative heterosupermolecular devices which combine the specificity and unique functionality of supermolecular chemistry with the nanometer scale strcutural control and ease of integration into electronic devices of nanocrystalline metal oxide electrodes.

News and Announcements

The project will be science focused, with specific technological objectives. Key scientific elements of the project will be the synthesis of supermolecular structures designed both to achieve the desired functionallity and including binding groups for ligation to metal oxide surfaces, the self-assembly of these structures on the surface of mesoporous, nanocrystalline films, the electrochemical and photochemical evaluation of the resulting heterosupermolecular systems, and the functional evaluation of these systems for technological applications.

The project will target the demonstration of four innovative heterosupermolecular devices: light emitting diodes, optical data storage devices, magneto-optical data storage devices and electro-optical sensing and switches.The proposal will be at the meeting point between supermolecular chemistry, nanostructured inorganic materials science and optoelectronic device physics. It is therefore highly multidisciplinary and involves leading European groups working in organic, inorganic, biology, physical and materials science.

This project will develop a critical mass of expertise targeting this innovative approach to optoelectronic devices, allowing Europe to establish a scientific world lead which will form a secure basis for technological exploitation.

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