UNIVERSITY OF TEXAS AT DALLAS - DEPARTMENT OF PHYSICS

PHYSICS COLLOQUIUM

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Nano-materials for organic and hybrid organic-inorganic optoelectronics

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Organic semiconductors are attractive for their multifunctionality, i.e. their ability to conjugate several properties such as charge carrier transport and electroluminescence. They offer the opportunity to fabricate optoelectronic devices on large area, low cost, flexible plastic substrates thus opening the possibility for a paradigm shift in information technology. I will discuss the fabrication and the characterization of light emitting field effect transistors (a new class of optoelectronic devices combining the transistor function with the light emission) based on tetracene films deposited on unusual substrates.

The investigation of hybrid organic-inorganic systems is of paramount importance in material science since positive synergistic effects in the final hybrid system can enhance the best performance of each component. Inorganic electroactive materials can be fabricated by "soft solution routes" providing exciting venues to produce a variety of materials with well controlled compositions, structures, and sizes. I will report on the preparation of mesoporous semiconducting films consisting of preferentially oriented monoclinic phase nanocrystals of WO_3 using a novel version of the sol-gel method. These well crystallized WO_3 films combine excellent photoresponse to the blue region of the solar spectrum, up to 500 nm, with good transparency at wavelengths larger than 550 nm. Particular applications of these nanocrystalline WO_3 films include photoelectrochemical and electrochromic devices.

Sn and SnO_2 films are extensively studied for applications in energy storage (high capacity anode materials for Li ion batteries), photocatalytic and photoelectrochemical solar energy conversion, and sensing. I will illustrate a new electrochemical synthetic condition to prepare Sn-containing films with wire morphology. This morphology can significantly minimize the randomness of the charge carriers' pathway and guide them efficiently. The synthetic ability to control morphological features of materials such as surface area and shape of the particles opens the possibility to engineer interfaces in multicomponent hybrid organic-inorganic devices employed e.g. in solar energy conversion.

About the speaker: Dr Clara Santato is, since 2001, Permanent Research Scientist at the Istituto per lo Studio dei Materiali Nanostrutturati affiliated to the Italian National Research Council. She obtained her M.Sc. degree in Chemistry form the University of Bologna after a diploma work carried out in collaboration with the Université J. Fourier, in Grenoble. She received her Ph.D. in Chemistry from the University of Geneva in 2001. In 1999, she was visiting student at the National Laboratory for Renewable Energy, (Golden, CO). In 2005, she was visiting scientist at Purdue University, IN. Since May 2006, she is visiting scientist at Université du Québec-INRS-EMT (Canada) in Prof. F. Rosei's group.