Monday Evening Poster Sessions, October 25, 1999

Organic Electronic Materials Topical Conference Room 4C - Session OE-MoP

Poster Session

OE-MOP1 STM/Photo-Assisted EFM Investigation of Morphology-Photoconductivity Relationships in Photogenerating Dye Molecule Thin Films, *M.E. Stawasz, N. Takeda, B.A. Parkinson,* Colorado State University

STM and photo-assisted EFM (Electric Force Microscopy) were used to study the relationship between morphology and photoconductivity for a photogenerating dye molecule used commercially in photoreceptor devices. Bis(4-dimethylamino-2-hydroxyphenyl) squaraine was adsorbed from solution onto the basal plane of HOPG. Several polymorphs of adsorbate structure were determined with STM. EFM coupled with a 0.5W 690nm diode laser to illuminate the sample surface was used to spatially resolve areas of differing polymorph in terms of their differing photoconductivity. By identifying regions of differing polymorph, then measuring the relative photoconductivities of each phase a polymorph structure-photoconductivity relationship was identified.

OE-MOP2 Ordered Thin Film and Organic Heterojunction Formation from Luminescent Organic Dyes, *D.M. Alloway*, *N.R. Armstrong*, University of Arizona; *A. Back*, Physical Electronics; *B. Schilling*, VG Micromass

Perylenes, phthalocyanines, certain quinacridones, and related dyes can be vacuum deposited to form ordered monolayers and multilayers. The ordering in these monolayers can be monitored with electron diffraction techniques, and scanning probe microscopies (STM/AFM), but we have recently also found that luminescence spectroscopies can be used to follow the nucleation and growth of the first monolayer, and subsequent multilayer formation. This paper will focus on recent studies of the growth of perylenetetracarboxylicdianhydridebisimide (PTCDI) dyes (both C4 and C5 tails on the bisimide), and substituted quinacridones on both single crystal metal and nonmetal surfaces. Layered growth is seen in all multilayer films, with flat-lying monolayers apparently formed in most cases, and where the structure of the 2nd and subsequent layers is strongly dependent upon the stable bulk structures for these materials. Luminescence spectroscopies indicate the degree of cofacial interaction between these dyes, during monolayer nucleation, and as layer-by-layer growth is achieved. For certain guinacridone dyes the substituent side chains control the approach distance of adjacent molecules, significantly altering the luminescence spectra relative to the parent molecule. In addition, luminescence spectra are useful in characterizing the degree of interaction between two dissimilar dyes, at the organic/organic' interface in a heterojunction assembly, and the degree of luminescence quenching appears to correlated with interface dipole formation as indicated by XPS/UPS studies.

OE-MoP3 Contact Resistance Measurements on Individual Grains of *@alpha@-Sexithiophene, A.B. Chwang, C.D. Frisbie,* University of Minnesota

We describe four point probe measurements on individual grains of the molecular semiconductor sexithiophene (6T). These measurements utilize thin 6T grains (2-14 nm in thickness and 1-2 μ m in length and width) deposited by vacuum sublimation onto SiO@sub 2@/Si substrates previously patterned with sets of four closely spaced (<400 nm) Au electrodes. The 6T grains grow between the four contacts and their electrical behavior is probed as a function of temperature and gate voltage applied to the substrate. From these data, we extract the Au-6T contact resistance and determine its sensitivity to both gate field and temperature.

OE-MOP4 Electronic Transport Properties of Self-assembled @pi@conjugated Azomethine Oligomers, *J.J.W.M. Rosink, L.J. Geerligs, E. van der Drift,* Delft Institute of Microelectronics and Submicrontechnology, The Netherlands; *A.I. Onipko,* Bogolyubov Institute for Theoretical Physics, Ukraine; *Y. Klymenko,* Space Research Institute, Ukraine; *B.A.C. Rousseeuw,* Delft Institute of Microelectronics and Submicrontechnology, The Netherlands; *S. Radelaar,* Netherlands Institute for Metals Research, The Netherlands

A novel technique for the controlled fabrication of @pi@-conjugated azomethine oligomers bonded to a substrate is presented. The resulting thin films can be used to study the intra-molecular electronic transport properties. Starting from a gold substrate, monolayers of small monomeric organic units are alternately deposited from solution. They order and connect to the previous layer by self-assembly. In each deposition step, chemisorption takes place at the interface between two monolayers through a condensation reaction. Oligomer chain growth has been

analyzed by ellipsometry, gaschromatography, mass-spectrometry and xray photoelectron spectroscopy (XPS). Molecular mechanics calculations support the observation from ellipsometry and XPS that the azomethine molecules order roughly perpendicular to the gold surface. Based on scanning tunneling spectroscopy (STS) experiments an electronic model for these experiments is proposed. The Green function method is used to establish the relationship between the I-V curves registered in the STS measurements and the @pi@-electronic structure of the oligomers of type M@sub 1@-M@sub 2@-M@sub 1@... probed in the experiments. We have succesfully fitted I-V curves observed in STS of a single monomer film. Modelling of organic multilayers with a particular focus on the role of molecule-to-metal contact is in progress.

OE-MOP5 Perfluorinated Alkane Self-assembled Monolayers Studied with XPS and ISS, *D.E. King, A.W. Czanderna,* National Renewable Energy Laboratory; *L.S. Dake,* Susquehanna University

Perfluorinated Alkane Self-assembled Monolayers Studied with XPS and ISS D.E. King, A.W. Czanderna, and L.S. Dake* National Renewable Energy Laboratory, MS-3214 1617 Cole Blvd. Golden CO 80401-3393 The purpose of our past work has been to use self-assembled monolayers (SAMs) as a model organic surface for studying the interactions and penetration of deposited metals on or through specific organic functional groups of the SAMs.@footnote 1@ Our future goal will be to study the interactions, reactions, and stability of deposited metals and metal oxides on SAMs, but in a simulated solar environment, e.g., UV irradiance, T to about 333 K, and in the presence or absence of humidity. Because we expect UV degradation to complicate studies with the n-methylene groups (6<n<21) in alkanethiols in our past work,@footnote 1@ we are reporting our feasibility studies with perfluorinated alkane (PFA) SAMs. We will discuss our approach for the assembly of PFASAMs by using an acid attachment group instead of a thiol and demonstrate the presence of a single monolayer film. We have characterized the PFASAMs by contact angle, XPS, and ISS. The erosion rates in ISS for PFASAMs of different chain-length and with several different end groups will be discussed as they relate to macroscopic film properties such as the contact angle. The stability of the PFASAMs during Xray exposures will also be compared with results of similar chain-length alkanethiols. @FootnoteText@@footnote 1@D.R. Jung, G.C. Herdt, and A.W. Czanderna, J. Vac. Sci. Technol., A14 (1996) 1779. This work was performed under DOE Contract No. DE-AC36-98GO10337.

OE-MoP6 Resonant Photoemission Study of Poly(p-PhenyleneVinylene), *Y. Park*, Korea Research Institute of Standards and Science, KOREA; *Y. So*, Korea Research Institute of Standards and Science; *G.S. Lee*, Korea Research Institute of Standards and Science, Korea; *E. Cho*, Chonnam National University, Korea

We have employed synchrotron radiation resonant photoemission technique to investigate the electronic structures of one of the prototype organic electroluminescent polymer Poly(p-PhenyleneVinylene) (PPV). When the photon energy was near the binding energy of C 1s core level, at least three strong resonacnes at the approximate binding energies of 5, 6.5, and 9 eV could be observed We discuss the origin of the observed resonances and identify the symmetries of related valence energy levels. The results of resonance photoemission on Ca-induced gap states formed in near-surface region of PPV thin film were also discussed.

OE-MoP7 Investigation of the Influence of LiF-Coatings on the Electronic Structure of Organic Semiconductor/Electrode Interfaces bv Photoemission Spectroscopy, R. Schlaf, State University of New York at Binghamton; P.A. Lee, K.W. Nebesny, N.R. Armstrong, University of Arizona Recently, it was demonstrated that the performance of organic light emitting diodes (OLED) can be considerably improved by inserting thin (~1nm) LiF layers between charge injecting electrodes and organic semiconductor layers. We have determined the electronic structure of typical metal/LiF interfaces with photoemission spectroscopy (PES). In our experiments LiF thin films were grown in multiple steps on sputter-cleaned Al, Pt and ITO substrates. Before growth of the LiF films and after each LiF deposition step the samples were characterized in-situ by combined X-ray and UV photoemission spectroscopy (XPS, UPS) measurements. Our results suggest that the LiF coatings considerably lower the work function of the electrode surfaces, hence resulting in a much reduced electron injection barrier between low work function electrodes and organic electron transport materials. In the case of Al electrodes a surface dipole created by chemisorbed water emitted from the LiF evaporation source is partially responsible for the work function reduction observed after the LiF deposition. Our measurements also demonstrate that even in insulators such as LiF effects similar to band bending in semiconductors may occur.

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The results suggest, that a redistribution of charged Schottky or Frenkel type defects in the LiF layers, caused by the thermodynamic equilibration between LiF and the contact metal, is possibly responsible for the observed phenomena.

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