Organic Films and Devices
Room Exhibit Hall B - Session OF-TuP
Poster Session

OF-TuP1 Fabrication of Micro-Pumps for Organic Micro-Fluidic Devises using Asymmetric Electrode Arrays*, H.G. Jeong*, *M. Dhayal,* Dongshin University, South Korea*; H.J. Lee,* Chonnam National University, Korea*; J.S. Choi,* Dongshin University, South Korea

Recently micro-fluidics devises are of a great interest to use in fabrication of "lab-on-a-chip" and micro electromechanical systems (MEMS). A new types of microelectrodes structures have been developed for controlling fluid movement in micro-systems using AC electric fields. In our research we are developing a design tool of asymmetric electrode arrays to fabricate micro-fluidic devises to use in control of different biological fluids. An optimisation of performance of the bio-MEMS fabricated using conventional techniques such as photolithography and reactive ion etching in our study has been also investigated.

OF-TuP2 Investigation on the Interfacial Reaction of Metal/Fluorinated Polymide*, C.-Y. Yang*, *S.L.-C. Hsu, J.-S. Chen,* National Cheng Kung University, Taiwan

In this work, the surface states of fluorinated polyimide synthesized from 6FDA-BisAAF-PPD, before and after plasma treatment, were characterized by X-ray photoelectron spectroscopy (XPS). The interfacial states of metal-fluorinated polyimide were examined by XPS after metal films of Cu, Cr and Au were deposited onto the fresh cured fluorinated polyimide with or without plasma treatment. The influence of plasma treatments on interfacial reaction was examined. XPS analysis results reveal that the surface of fluorinated polyimide will be oxidized and nitridated after O2 and N2 plasma treatment. In the metal/polyimide interface, chemical bonding of Cr-C is observed in the untreated polyimide system. However, no metal-carbon bonding is found in the Cu, Au and polyimide interface. Slight interface change is observed after the N2 plasma treatment. In addition to M(metal)-C bonding, M-C-O bonding is also observed at the metal-polyimide interface in those samples with O2 plasma applied to the polyimide surface. The relationship between adhesion and interfacial reaction of metal/fluorinated polyimide, and the role of fluorine in the interfacial reaction are also discussed.

OF-TuP3 XPS and FTIR Studies of Dye Molecule Doped Conducting Polymer Films*, H. Kato*, *S. Takemura,* Kanto Gakuin University, Japan*; O. Nishikawa, M. Taniguchi,* Kanazawa Institute of Technology, Japan

Conducting polymer polythiophene(PT) films incorporated with dye molecule such as brilliant green(BG) were prepared by electrochemical doping and diffuse injection methods. Charge transfer and interaction between the doped dye molecule and PT polymer chains were investigated by analyzing the core-level energies and spectral profiles of the atomic components. Vibrational states of the doped dye molecule and the polymer backbone were also investigated by FTIR RAS and ATR in order to examine the dopant configuration into polymer chains in the hybrid films. In the case of brilliant green doping, XPS core-level analysis of S 2p split indicates simultaneous doping of BG cation and HSO4- in the hybrid films prepared by electrochemically reduced and dye diffuse injection methods. Synthesized film samples were categorized into two types by the difference of S 2p core-level energy shift. In the cation-like doped sample, the energy shift of the lower peak of S 2p suggests the charge transfer between BG molecule and polymer chains creating a n-type conducting polymer state. The polymeric state and the dopant configuration were also investigated by FTIR. CH in plane modes of the PT backbone which appeared around 750 cm-1 and ring stretching modes which appeared around 1050 cm-1 indicate the polymeric structure based on a thiophene ring. The profile of the vibrational spectra reflected the detailed polymeric structure. The orientation of the dopant BG molecule in the hybrid films was discussed by analyzing the benzene out-of-plane mode of a BG molecule which appeared at 2000 cm-1.Three possible BG configuration models were closely discussed.

OF-TuP4 Effects of High Electric Fields on Charge Transport and Morphology in Solution Processed Conducting Polymer Films*, P.S. Chung*, *P.H. Holloway,* University of Florida

One of the attractive qualities for using organic materials for electronic applications is their ability to be processed in solution, which ultimately leads to lower processing costs. A major obstacle preventing organic electronics from obtaining a greater share in todayâ?Ts technological markets is their inferior performance characteristics when compared to traditional inorganic materials. Polymer and molecular orientation are key issues in governing the electrical and morphological properties of the film. In this study, spincoated films consisting of p-type polymers (i.e. polyvinyl carbazole) and n-type dye molecules (i.e. 3,9-perylenedicarboxylic acid dissobutyl ester) are subjected to high electric fields (200 V/cm to 15,000 V/cm) during solvent evaporation. The polar sidegroups and branches on the polymer and molecule adjust their orientation under the electric field, thereby improving the electrical and morphological properties of the film. Models to quantitate these effects will be presented and discussed.

OF-TuP5 Topology and Growth Behavior of Evaporated Organic Films on Crystalline Metal Layers: Perylene-3,4,9,10-Tetracarboxylic Dianhydride (PTCDA)*, K. Seo*, *M. Haythe, C. Bonner,* Norfolk State University

PTCDA films were prepared on metal films under four different deposition conditions employing all combinations of low and high substrate temperature with various deposition rates. The films were grown by organic molecular beam deposition (OMBD) in an ultrahigh vacuum chamber from a Knudsen cell, using sublimation temperatures of 430, 380 and 330 ºC, respectively. The grazing-incident-angle x-ray diffraction (GIXD) technique has been measured the anisotropy of the structure in the directions perpendicular and parallel to its surface. We have used the real-time in-situ spectroscopic ellipsometry to determine the optical functions of PTCDA films. The influence of the substrate temperature on the metal films is investigated using spectroscopic ellipsometry and atomic force microscopy. We have found that the grain size of the crystallites and surface roughness increase with increase substrate temperature.

OF-TuP6 Poly(3-hexylthiophene) Organic Thin Film Transistor on Polyimide using Electroplated Gold Electrodes*, J.G. Lee*, *S.H. Cho, S.W. Na, N.-E. Lee,* Sungkyunkwan University, South Korea

Organic thin film transistors (OTFT) on flexible substrate using electroplated gold electrodes have potential advantages in the fabrication of low cost sensors, smart cards, and field-effect transistors. This method can be a competitive candidate for OTFT applications requiring large area coverage, structural flexibility, low temperature processing, and especially low cost. In particular, the application of electroplating enables one to obtain electrode with high aspect-ratio and good reliability in terms of mechanical flexibility and thermal stress. In this work, poly(3-hexylthiophene) (P3HT) OTFT device uses a top gate structure with electroplated Au source and drain electrodes. Organic thin film transistors (OTFTs) were fabricated using (P3HT) as a semiconducting layer and electroplated gold (Au) as source and drain electrodes. First, since the adhesion of electrodes on the flexible substrate is of great importance for the application in flexible devices, the adhesion improvement of electroplated electrode structures was investigated by plasma treatment of polyimide substrate by using Au/Cu/Cr/polyimide structures. Cu(seed)/Cr(adhesion) layers were sputter-deposited in sequence on the plasma-treated polyimide substrate. Then, a negative photoresist, SU-8, was spin-coated on the Cu/Cr/polyimide substrate and patterned by ultra-violet photolithography for source and drain electrodes. After photolithography, Au source and drain electrodes were electroplated into the patterned SU-8 mask. After P3HT film was spin-coated, SiO@sub 2@ gate dielectrics and Al electrode were evaporated with a shadow mask. The channel length ranged between 10 and 25 µm, and the channel width was 800 µm. Electrical properties of fabricated OTFT were characterized and the effect of various process conditions and structures on the performances of fabricated devices will be discussed. Keyword Organic thin film transistor, P3HT, Au electroplating, polyimide, flexible devices.

OF-TuP7 Influences of Ion Irradiation for Depositing Aluminum Cathode in Organic Light-emitting Diodes*, S.M. Jeong*, *W.H. Koo, S.H. Choi, S.J. Jo, H.K. Baik,* Yonsei University, Korea*; S.J. Lee,* Kyungsung University, Korea*; K.M. Song,* Konkuk University, Korea

To demonstrate the effects of argon ion irradiation during cathode deposition, aluminum cathode prepared by ion beam assisted deposition process on spin-coated soluble phenyl-substituted poly-p-phenylene-vinylene (Ph-PPVs) thin films have been investigated and compared to those by thermal evaporation. Although energetic particles of Al assisted by Ar+ ion may damage the organic material, I-V-L characteristics are improved by applying thin Al buffer layer. It may be deduced from the smaller contact resistance between Al and Ph-PPV induced by large contact area, increase of density of state and lithium diffusion in ion beam assisted device. In addition, highly packed structure of Al cathode inhibits the permeation of H@sub 2@O and O@sub 2@ into Ph-PPV film through pinhole defects, and thus retards dark spot growth. In conclusion, the lifetime of organic light-emitting device (OLED) has been extended through ion beam assisted deposition process.

OF-TuP8 The Effect of Atmospheric Pressure Plasma Treatment on Indium Tin Oxide Anode for Organic Electroluminescent Devices*, **S.H. Choi**, S.M. Jeong, W.H. Koo, H.K. Baik,* Yonsei University, Korea*; S.J. Lee,* Kyung Sung University, Korea*; K.M. Song,* Kon Kuk University, Korea

The effect of atmospheric pressure plasma (APP) treated indium-tin-oxide (ITO) substrate on poly (9,9-dyoctilfluorene) (PFO)-based light-emitting diodes was studied. It was found that the chemical composition and surface roughness at the ITO surface were changed after APP treatment. Organic light-emitting diodes (OLEDs) fabricated on APP treated ITO surfaces showed three times better electroluminescence and current injection than OLEDs fabricated on as-received ITO surfaces, due to the increase of the smooth contact area between the ITO surface and the organic layer. The ITO substrate after APP treatment showed similar behavior of LPOP. Therefore, APP is an effective treatment for enhancing the performance of OLEDs.

OF-TuP9 Characterization of Porphyrin Monolayers Bearing (O, S, and Se) on Si and Au: Towards Hybrid Memory Storage in Electronic Devices*, **A.A. Yasseri**, F. Zaera,* University of California Riverside*; J.S. Lindsey,* North Carolina State University*; D.F. Bocian,* University of California Riverside

We report on the characterization of a novel group of redox-active porphyrin molecules synthesized with terminal chalcogen subunits for attachment on to electro-active surfaces. A series of porphyrins has been prepared and characterized as surface bound redox-active monolayers. The molecules designated as (ZnPBz-,ZnPCH2-) bear two linker types substituted on a meso-position of the porphyrin and are terminated with a diverse series of surface anchor groups in free and protected form (hydroxy, S-acetylthio, and Se-acetylseleno) for attachment to Si (100) and Au (111). Communication with the covalently bound adsorbates is achieved through activation of pre-patterned Si-hydride test-platforms to anchor the Si-O, Si-S, or Si-Se tethers to the surface. Similar monolayers were prepared as SAMs on Au yielding analogous Au-S and Au-Se tethers for comparison. Each porphyrin was investigated on Au and Si surfaces using X-ray photoelectron spectroscopy, Fourier transform infrared spectroscopy, and various electrochemical methods including (fast scan cyclic voltammetry, swept-waveform AC voltammetry, and open circuit amperometry). The objective of the study was to demonstrate the (1) the chemical robustness of monolayer binding through each anchor group to the surface, (2) measure the packing density of the molecular monolayers on each surface, (3) and to probe the influence that terminal surface anchor groups (O, S, Se) and linker type bear on the electron transfer (in presence of applied potential) and charge retention (in absence of applied potential) characteristics of the monolayers on each platform. XPS, FTIR, and voltammetric measurements confirm semi-quantitative displacement of surface di-hydride species with -O, -S, and -Se terminated porphyrins, respectively. The electron transfer kinetics of the Si-O, Si-S, and Si-Se indicate that the kinetics strongly depend on the linker type and surface concentration of the porphyrin monolayers, independent on the substrate used.

OF-TuP10 Assembly of Synthetic Molecular Motors on Surfaces*, **T. Takami**,* Visionarts Research, Japan*; T. Ye,* The Pennsylvania State University*; J.M. Tour,* Rice University*; K.-I. Sugiura,* Tokyo Metro. Univ., Japan*; P.S. Weiss,* The Pennsylvania State University

We attempt to assemble synthetic molecular motors mounted on Au{111} and graphite surfaces. Two kinds of molecular motors are proposed: (1) in-plane rotation of molecular rotors: the substrate-bound shaft of the rotor assembly, a metal porphyrin is attached to the shaft through axial ligation with a pyridine group, (2) perpendicular rotation of molecular rotors: sandwich porphyrins are used for the tables to stand on the surface and a perpendicular bifunctional shaft is attached between the porphyrins. The rotation of the molecular motors will be imaged with scanning tunneling microscope (STM) in air and in solution, and will be detected via single molecule resonance spectroscopy with alternating current STM (ACSTM).

OF-TuP11 Chemical Conversion Patterns of the 1,7-octadien Monolayer on Si(111) Surface*, **S.H. Lee**,* Nagoya University, Japan*; N. Saito,* Nagoya University, Japan, Japan*; T. Ishizaki, O. Takai,* Nagoya University, Japan

The organic monolayer covalently attached to silicon has been expected to have a better chemical resistivity compared to organosilane monolayer. The Si-C interface provides a good electronic property for molecular devices constructed on silicon substrate. Many researchers have reported the structural configurations and the chemical bonding states of such organic monolayers. However, scanning probe lithography on the organic monolayers has been reported scarcely. In particular, the electronic properties of nanopattern lithography have not yet been understood. In this study, we investigated the surface potential at the locally scanned area, i.e., nanopattern, onto an organic monolayer formed on a Si substrate. An oxide layer on a Si substrate was removed using chemical etching for 15min in NH4F solution. The substrate was immersed in 1,7-octadien (OD) solution heated at 120°C for 1hour. The OD molecules reacted with the hydrogen-terminated Si surface, resulting in the formation of an OD-monolayer on the substrate. Atomic force microscope (AFM) lithography on the OD-monolayers resist was performed using SPI-3800N AFM with a Si probe in contact mode by applying a positive or negative bias. The pattern on the OD-monolayers resist was fabricated by VUV irradiation thorough a mask. The chemical changes of the OD surfaces were traced by Kelvin probe force microscope (KFM), AFM and fluorescence-labeled spheres.

OF-TuP12 Site Specific Binding of Analyte Gases on Metallophthalocyanine Thin Films: Dft Calculations and Sticking Probability Measurements*, **N.L. Tran**,* University of California, San Diego, U.S.A*; G.C. Poon, S. Bishop, A.C. Kummel,* University of California, San Diego

Several groups report the use of metallophthalocyanines (MPcs) as thin film resistive sensors for analyte gases such as NO@sub x@, CO, O@sub 3@ and NH@sub 3@; however, the chemisorption energies and mechanisms for these gases reacting with various MPcs have not been studied. Density functional theory (DFT) calculations performed in this study show that chemisorption energies vary strongly with metal center and analyte. These calculations also investigate the mechanism of chemisorption. Four analyte binding sites on the MPcs were investigated computationally: (i) metal centers, (ii) inner ring nitrogen atoms, (iii) outer ring nitrogen atoms, and (iv) organic rings. For NO@sub 2@ on FePc and CoPc as well as NH@sub 3@ on FePc , the simulations show chemisorption onto the metal centers and physisorption onto the outer ring nitrogens and organic rings. These calculations also show a multi-step absorption mechanism in which NO@sub 2@ initially binds to the inner ring nitrogens and subsequently migrates to the deep chemisorption well on the metal centers for FePc and CoPc. In contrast, only physisorption was observed for any bonding sites of NO@sub 2@ on NiPc and NH@sub 3@ on CoPc and NiPc. Sticking experiments are being performed to investigate the chemisorption mechanism and selectivity.

OF-TuP14 Organic Polymer Thin Films Deposited on Silicon and Copper by PECVD Method and Characterization of Their Electrochemical and Optical Properties*, **I.-S. Bae**, S.-H. Cho, Z.T. Park, J.G. Kim, J.-H. Boo,* SungKyunKwan University, South Korea

Polymer-like thin films have been deposited on glass, silicon and copper substrates at temperature range of room temperature and 100 °C by plasma enhanced chemical vapor deposition (PECVD) method using Cyclohexane as a precursor for analysis their electrochemical and optical characteristics. Cyclohexane was utilized as organic precursor, and hydrogen and Ar were used as a bubbler and carrier gases, respectively. In order to compare the difference of the corrosion resistant and the optical properties of the plasma polymerized organic thin films with conditions of various RF (radio frequency using 13.56 MHz) power in the range of 20~50 W and deposition temperature. The optical and electrical properties of the as-grown plasma polymerized thin films were analyzed by FT-IR, UV-Visible spectroscopy, I-V and C-V curves. The corrosion protective abilities of Cyclohexane were also examined by AC impedance measurements in 3.5 wt.% NaCl solution. We found that the corrosion protection efficiency (P@sub K@), which is one of the important factors for corrosion protection in the interlayer dielectrics of microelectronic devices application, was increased with increasing RF power. The highest P@sub K@) value of plasma polymerized Cyclohexane film was (85.26% at 50 W), AFM and SEM showed that the polymer films with smooth surface and sharp interface could be grown under various deposition conditions.

OF-TuP15 Damage Mechanism of Emitting Polymer Treated by Low Pressure Plasma*, **D.Y. Lee**, H.K. Baik,* Yonsei University, Korea*; K.M. Song,* Konkuk University, Korea*; S.J. Lee,* Kyungsung University, Korea

In this study, we investigated the damage mechanism of emitting polymer (poly(9,9-dioctylfluorene)(PFO)) films for organic light emitting diode (OLED). For top emission organic light emitting diode (TOLED), indium tin oxide (ITO) films are used as a cathode material due to its high transparency in visible light. In conventional, ITO is deposited by RF/DC magnetron sputtering. But there have been many reports that sputtering process including high energy ions and neutrals degrades emitting polymer. Therefore, metal buffer layer must be inserted between emitting polymer and ITO films, not only to improve electron injection but also to prevent polymer damage. It is very important to reduce a thickness of buffer layer as thin as possible so that low driving voltage and high transparency are achieved. However, low thickness of buffer layer is not effective in prevention of polymer damage from magnetron sputtering. So, this problem is pending unsolvable. We used plasma treatment on emitting polymer (PFO) to eluciate damage mechanism so as to find effective solution for polymer degradation. Low pressure glow discharge was perform with He and O2 gas at 2ï,´10-1 torr. Anode electrode is patterned ITO films and hole transport layer is PEDOT. Al/LiF films were deposited on blue Emitting polymer (PFO) as a electron injection layer and cathode buffer. ITO films was fabricated by RF magnetron sputtering at room temperature. ITO target (SnO2: In2O3 = 1: 9) was sputtered by mixture gas of argon and oxygen. Oxygen partial pressure, working pressure and other deposition parameters were optimized. RF coupled DC was used as a power source and its voltage was changed from 45 V(only RF) to 350 V(only DC). The temperature of cesium reservoir was varied from 80 to 200 Â°C. Negative sputtered particles including In, Sn, O and electron were generated from the target surface and accelerated to the substrate by target voltage.

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