SYMPOSIUM B

Flat-Panel-Display Materials and Large-Area Processes

April 13 - 17, 1998

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* Invited paper

TUTORIAL

STB/C: FLAT PANEL DISPLAY MATERIALS AND LARGE AREA PROCESSING
Monday, April 13, 1:30-5:00 p.m.
Nob Hill B/C

This course will provide an overview of the Flat Panel Display (FPD) market and detailed discussion of dominant and emerging FPD technologies. Topics include display-market trends, thin-film transistor technologies for active matrix liquid-crystal displays (AMLCD), reflective LCD technologies, Organic Light-Emitting Devices (OLED) technology, phosphor materials and Field Emission Display (FED) technologies, and plasma display technology. It is intended to serve as an introductory course for entry-level engineers and also to provide a survey of recent developments in FPD technologies for display industry professionals.

Instructors:
Tsu-Jae King, University of California-Berkeley
Bruce Gnade, DARPA

SESSION B1/A1: JOINT SESSION:
AMORPHOUS AND POLY-Si TFTs
Chair: Ruud E.I. Schropp

structure: glass substrate /indium-tin-oxide/PVK/PDD/Al. Carrier injection from electrode to the PDD layer and concomitant electroluminescence from PDD and its derivative were observed. Blue and blue-green emissions peaking at 468nm and 500nm from PDD and its derivative respectively were achieved.

B10.9

A NOVEL BLUE ELECTROLUMINESCENT DYE CONTAINING HETEROCYCLIC GROUPS. Xie Zhiyuan, Chen Baijun, Huang Jingsong, Liu Shiyong, Jilin Univ, Dept of Electronics Engineering, Changchun, CHINA.

In this paper, we demonstrated the synthesis of a novel blue-luminescent compound, 1-benzothiazoly-3-phenyl-pyrazoline (BTPP1), and investigated its optical and electric characteristics. This heterocyclic compound exhibited good characteristics of blue photoluminescence and electroluminescence, which had the emission peak at 451nm.The results of elemental analysis and 1H NMR confirmed the proposed molecular structure.The energy gap Eg, the molecular ionization energy I and the electron affinity A were found to be 3.07eV,-5.77eV and -2.70eV with cyclic voltammetry method respectively. The single layer light emitting devices consisted of a spin coated approximately 100nm-thick poly(N-vinylcarbazole)(PVK) layer doped with BTPP and sandwiched between ITO glass and a vapor deposited aluminum contact. The EL peak was at 451nm and luminescence can be reached to 60cd/m2 at a current 10m/cm2.

B10.10

HIGH QUALITY Si/SiO_2 INTERFACE PREPARED BY HIGH DENSITY PLASMA CHEMICAL VAPOR DEPOSITION. Moon-Youn Jung, Eui-Hoon Hwang, *Sung-Woong Jung, Dac-Gyu Moon, Won-Kyu Park, Hoi-Seop Soh, LG Electronics Inc. LCD Division R&D, *LG Semicon Co., Ltd., Anyang, SOUTH KOREA.

High quality SiO_2 films have been deposited by high density plasma (HDP) chemical vapor deposition as a gate dielectric material for poly-Si TFT. HDP using inductively coupled plasma(ICP), has higher plasma density than those of normal capacitively coupled plasma (CCP), and dose not induce the ion bombardment on underlying substrate. HDP-CVD SiO_2 film exhibits good electrical properties (interface state D_x of ≈2 x $10^9/cm^2$ eV, effective charge density N_{eff} of ≈1.3 x $10^{11}/cm^2$, breakdown strength of 8 MV/cm). HDP-CVD method can be deposited with very high deposition rate (≈50 Å/sec). The results indicated that HDP-CVD SiO_2 films may be promissing CVD method for poly-Si TFT-LCD applications on large glass substratate.

B10.11

LOW TEMPERATURE FORMATION OF SiN_x GATE INSULATOR FOR THIN FILM TRANSISTOR USING CAT-CVD METHOD. A. Izumi, T. Ichise and H. Matsumura, JAIST(Japan Advanced Institute of Science and Technology), Ishikawa, JAPAN.

Silicon nitride (SiN_x) films prepared by low temperature are widely applicable as gate insulator films of thin film transistors (TFT) of liquid crystal displays (LCD). In this work, SiN_x films are formed using deposition and direct nitridation method at low temperature around 300ºC by cat-CVD method. In this method, SiH_4 and NH_3 gases (in the case of deposition) or NH_3 (in the case of nitridation) are decomposed by the catalytic cracking reactions with a heated tungsten catalyzer placed near substrates, and so that SiN_x films are formed without any help from plasma nor photochemical excitation. The electrical properties of cat-CVD SiN_x films are investigated. It is found that, 1) the resistivity and breakdown electric field are 10^{14} Ωcm and 6-8 MV/cm, 2) Small flat band voltage shift of C-V characteristic (below 0.2 V) is observed. These results shows the usefulness of cat-CVD SiN_x films as gate insulator material for TFT.

B10.12

LOW TEMPERATURE FLOATING PLASMA OXIDATION OF POLY-SI AND POLY SIGE. Zhineng Fan, Gang Zhao, Paul K. Chu, Department of Physics and Materials Science, City University of Hong Kong, HONG KONG; Zhonghe Jin, Hoi S. Kwok, Man Wong, Department of Electrical and Electronic Engineering, The Hong Kong University of Science and Technology, HONG KONG.

Low temperature oxidation is an essential process for thin-film transistors (TFT) used in active-matrix liquid crystal displays (AMLCD). However, low temperature oxidation gives rise to defects at the SiO_2/poly-Si and SiO_2/poly-SiGe interfaces. We have recently developed a novel plasma oxidation method for poly-Si and poly-SiGe materials. The poly-Si and poly-SiGe wafers are soaked in a 100mTorr pure oxygen RF (Radio Frequency) plasma, and unlike conventional ion plating oxidation, the wafers are isolated. The sample voltage is the same as the sheath potential of the floating wall, which is always negative since electrons move faster than ions. The defects caused by ion impact can therefore be reduced. No heating is applied during oxidation, as the sample is heated slightly by the plasma. Under our conditions, the temperature is below 100ºC even after oxidation for two hours. The oxide growth rate depends on the plasma conditions, and increases when a positive voltage is applied to the sample stage. Depth profiles are acquired by XPS and the

oxide/substrate interface is examined by XPS and TEM.

B10.13
SYNTHESIS AND PROPERTIES OF CHIRAL 2-PHENYLPYRIMIDINE LIQUID CRYSTALLINE COMPOUNDS. Lu Wanfang, Shang Yonglia, Department of Chemistry, Nanjing University, Nanjing, CHINA; Lu Youmei, Din Hui, Shanghai Institute of Organic Chemistry, Academy of Science, Shanghai, CHINA; Youdou Zheng, Department of Pysics, Nanjing University, Nanjing, CHINA.

13 new chiral compounds of 2-phenylpyrimidine with two alkyloxy terminal groups in which the one is a (S)-2-methyl-l-butoxy and the another is a RO- or a R'OCH$_2$CH$_2$O-group were synthesised. Their Chemical structures were all determined by IR, ^{1}HNMR, MS and elementary analysis and their mesomorphic properties have been investigated by optical polarizing microscopy and differential scanning calorimetry. The results show that they all have a smectic phase and some of them have a chiral smectic C phase. The effect of different terminal groups on the mesomorphic properties was discussed.

B10.14
A NEW TEXTURE IN THE POLYMER NETWORK STABILIZED FERROELECTRIC LIQUID CRYSTAL. Jianjun Li, Zongkai Wang, Zhihua Ling, Ximin Huang, Liquid Crystal Lab, Changchun Inst. of Pysics, Changchun, CHINA.

Recently polymer network stabilized ferroelectric liquid crystal devices(PNFLCDs) was developed to solve anti-shocking problem of SSFLCDs . In this paper, the effects of polymer network to the ferroelectric liquid crystal molecular alignment has been studied. Ferroelectric liquid crystals (FLC) and liquid crystalline polymer mixture were produced. The concentration of diacrylate monomer and photoinitator was doped from 1wt%-5wt%. The polymer monomer is curing under UV irradiation in the SA or Sc* phase . The PNSFLC samples have been observed with 1000B SEM equipment in order to clarify the polymer network structure formed in cells. From the photo,it is found that anisotropic network was formed and the size of the most network is less than 10

B10.15
PHASE SEPERATION THEORY AND APPLICATION -PHASE BEHAVIOUR AND MORPHOLOGY OF POLYMER/LIQUID CRYSTAL BLENDS. Yong Cai, Yayan Liu, Hongwen Ren, Ximin Huang, Liquid Crystal Lab, Changchun Inst. of Physics, Changchun, CHINA.

Recently,Liquid Crystal Displays(LCDs) have taken advantage place in the information display market.Polymer Dispersed Liquid Crystal(PDLC) displays are an interesting new use in liquid crystal displays.Liquid crystals dispersing as microdroplets in a polymer matrix can form PDLC film. The most important process of fabrication PDLC films is the phase seperation process. The temperature at which phase seperation is allowed depends on the relative concentration of the liquid ctystal and prepolymer ,as well as on the relative solubility of the two components of the mixture.Phase diagram for liquid crystal/prepolymer solutions can be mapped using optical and calorimetric means. Calorimetry is sensitive enough to determine the phase diagram.According to the phase diagram,the photopolymerization temperature and the concentration of the components have great effects to the phase transition and the morphology of the blends. The liquid crystal used in our experiment is nematic LC BL-002.The prepolymer used is Poly-Betyldem acrylate P-BDA. The blends with BL-002 compositions from 20 to 100wt% were mechanically mixed at the temperature of 80centigrate.Using DSC analysis we obtain the phase diagram of blends.Using polarized microscope we obtain the morphology picture of the blends. The different morphology are given by different polymerizating temperature.The phase seperation results depand on the size of the region beween the binodal and spinodal curves,the size of the activation barrier within the metastable region and other factors.According to the information from the diagram and technology condition,we can get the phase seperation morphology which we prefer.

B10.16
NEW METHODS DETERMINING THE CONDUCTIVITY OF PHOSPHOR SCREEN. Shin Sung Kim, Jong Duk Lee, Seoul National Univ, School of Electrical Eng'g; Jae Soo Yoo, Chung-Ang Univ, Dept of Chemical Engineering, Seoul, KOREA.

New methods are suggested with regard to determing the conductivity of phosphor screen, which is quite appropriate for the powder phosphor screen. Measurements are carried out with field emitters as an electron source and phosphor screen as an anode, the structure much like a field emission displays(FED). By regressing the measured luminance vs. anode current, the effective resistance of the phosphor screen could be obtained. The one determined in this way includes photoconductivity as well as electrical conductivity and may simulate the exact situation of FED application. Through the measurements, typical values of ZnO:Zn and ZnGa2O4:Mn phosphor screens are reported and discussed in the light of low-voltage characteristics.

B10.17
A STRUCTURE OF ELECTROLUMINESCENT USING SILICON TIPS. G. Yuan, J.M. Sun, H. Jing, T.M. Zhou, H. Jiang, B.L. Zhang, C.C. Jin, Y.X. Jin, Changchun Institute of Physics, Chinese Academy of Sciences, Changchun, CHINA.