Flat Panel Displays
Room Exhibit Hall C & D - Session FP-TuP
Poster Session

FP-TuP1 Fabrication and Characterization of Blue Light Emission from a Well-Type Field Emitter Device Implementing a Thin Film ZnO:W Phosphor*, V. Bhatia*, *H.R. Kim, M.H. Weichold,* Texas A&M University

Flat panel displays based on the principals of field emission, in theory, can delivery a picture quality comparable to a cathode ray tube at lower voltages with efficient phosphors. Microtip fabrication and availability of low voltage blue light emitting phosphors have been some of the key issues of research for the commercialization of these displays. This paper presents the fabrication of lateral edges as electron sites to produce blue light from the co-deposited thin film of zinc oxide and tungsten. The phosphor used in the lateral edge field emitter device has been fabricated at Texas A&M University@footnote 1@ by co-depositing zinc oxide and tungsten and annealing the thin film under appropriate annealing conditions. Phosphor emits blue light (490nm) at voltages as low as 300 V. It has been determined that the formation of ZnWO@sub 4@ was responsible for the emission of blue light.@footnote 2@ The device design to implement the blue phosphor is based on the design provided by L. D. Karpov.@footnote 3@ For the emission of electrons to excite phosphors, emitters have been fabricated by a combination of metal-carbon-metal layers as the lateral edges of wells formed in a dielectric material. Phosphors are fabricated at the bottom of the wells above anode lines. The fabrication steps of the blue light emitting lateral edge emitter along with phosphor characterization, efficiency measurements, and current-voltage characterization are presented in this paper. @FootnoteText@@footnote 1@Technology Disclosure to TAMU Technical Licensing Office (1993). @footnote 2@J. B. Sobti, P. M. Babuchna, V. Bhatia, M. H. Weichold. Paper presented at Spring, 1999, MRS meeting. @footnote 3@L. D. Karpov, V. A. Dratch, V. S. Zasemkov, A. P. Genelyev, Y. V. Migorodsky, and S. B. Proskournin. Technical digest of the 6th International vacuum Microelectronics Conference, Newport, RI, 1993.

FP-TuP2 Optical Filters for Plasma Display Panels using Organic Dyes and Sputtered Multilayer Coatings*, T. Okamura*, *S. Fukuda, K. Koike, H. Saigou, M. Yoshikai, M. Koyama, T. Misawa, Y. Matsuzaki,* Mitsui Chemicals, Inc., Japan

We describe optical filters for plasma display panels (PDP). PDP emit strong electromagnetic (EM) radiation and intense near-infrared light (NIR). The EM radiation is limited by regulations, and NIR emission causes malfunctions of devices working through NIR. The essential constituents of the developed optical filter are sputtered multilayer coatings and dye-containing layers. The sputtered multilayer coatings comprising alternate layers of metal and high-refractive material show both EM shielding effect and NIR cut-off ability without sacrificing high visible-light transparency. In addition, their reflectance should be reduced in order to improve viewability. Therefore the multilayer coatings are designed by utilizing optical admittance loci and the admittance diagrams to minimize interfacial reflection between the multilayer and the polymeric layer adjacent to it which protects the multilayer coatings and is used for adhering polymeric film such as an anti-reflection film. We obtained 7-layer (Silver and Indium-Tin-Oxide) coatings on polyethylene terephthalate substrates by roll-to-roll process, with surface resistance of 2.2@ohm@/sq., NIR transmittance of 1~12 % in 800~1200nm, visible-light transmittance > 74%, and interfacial reflectance < 0.5%. Since transparent colors of these coatings are usually greenish, we used dyes to neutralize the transparent color. The dyes are also applied to control color temperatures and minimum perceptible color differences of PDP. For this purpose, we have also developed a software tool to simulate optical designs for a given emission spectrum of PDP. The performance of this tool will be also presented.

FP-TuP3 Fabrication of a Planar Field Emitter Array on the Diamond Like Carbon Layer*, D.H. Lee*, *D.W. Kim,* Sungkyunkwan University, Korea*; S.I. Kim,* Skion Corporation, Korea*; G.Y. Yeom,* Sungkyunkwan University, Korea

Diamondlike carbon(DLC) based field emitters can be practically important in the fabrication of field emission display not only due to the properties possessed by diamond such as electronegativity, thermal stability, mechanical hardness, and chemical inertness but also due to the possibility of low temperature deposition and large area deposition. In this study, a novel DLC-based field emission device based on a planar field emitter has been designed and fabricated and its electrical properties were investigated. To maximize the field emission of the planar type field emitter, the shape and dimension of the device were simulated using a simulation tool. The deposition technique of DLC layer is very important because it can vary the emission properties of the fabricated DLC field emitter. To obtain desirable properties of DLC layer, a novel Cs ion assisted magnetron sputtering deposition technique developed by SKION Inc. was used to deposit the DLC layer at room temperature. The room temperature deposited DLC layer showed mechanical and electrical properties close to diamond The fabricated planar type DLC-based field emission device was consisted of DLC/bottom electrode/insulator/top electrode. The bottom electrode has a circular opening to expose the field emitting DLC layer. The slope of the bottom electrode opening, the thickness of the insulator layer, and the opening of the top electrode in addition to their materials were optimized to obtain a stable FED structure and the necessary electric field for electron emission and convergence of the electron beam. Details of the fabrication techniques and the electrical properties of the fabricated field emission devices will be discussed. Also, the properties of DLC layer deposited by Cs ion assisted magnetron sputtering will be also discussed.

FP-TuP4 Effects of ZnO Buffer Layer on the Luminous Properties of Thin Film Phosphors Deposited on ZnO/ITO/Glass Substrate*, Y.J. Kim*, *Y.H. Jeong, S.M. Jeong,* Kyonggi University, Korea

Thin film phosphors deposited on ITO(Indium tin oxide) coated glass panel have a disadvantage of lower cathodoluminescent brightness than powder types due to the poor crystalline quality. It is very difficult for thin film phosphors to have high quality crystal structures, because ITO has an amorphous like structure. To improve the cathodoluminescent properties of thin film phosphors, ZnO buffer layer was deposited by sputtering methode between thin film phosphors and ITO coated glass substrate. All thin film phosphors were deposited by rf magnetron sputtering method. Transparent c-axis preferentially oriented ZnO thin film buffer layer could be obtained on ITO thin film, while ITO had an amorphous like structure. ZnGa@sub 2@O@sub 4@:Mn and CaTiO@sub 3@:Pr thin film phosphors were used to evaluate the effects of ZnO buffer layer. The crystal structures of thin film phosphors deposited on ZnO/ITO/glass substrate were developed better than those on ITO/glass, consequently the formers showed cathodoluminescent intensity at least twice as high as the latter. CaTiO@sub 3@:Pr and ZnGa@sub 2@O@sub 4@:Mn thin film phosphors showed sharp CL emissions at 613nm and 509nm, respectively.

FP-TuP5 Investigation of the Outgassing Characteristics of the Materials Consisted of Plasma Display Panel*, H.R. Han*, *Y.J. Lee, G.Y. Yeom,* Sungkyunkwan University, Korea

In the fabrication of PDP, before filling with light emitting gases (Xe+Ne, etc.) to the fabricated panel, the panels are exhausted through a small section glass pipe attached to one side of the rear glass substrate of the panel. Currently, this gas exhausting takes more than several hours to obtain a desirable vacuum state of around 10@super -7@Torr due to the outgassing from the materials inside of the panel. It is known that this gas exhausting process is one of the most time-consuming processes that reduces the production rate and increases the cost of PDP. However, at present, the affecting factors or the materials causing the severe outgassing from the panel during the exhausting are not well understood due to the variety of materials and complex processing involved in the fabrication of the PDP. In this study, outgassing characteristics of the materials consisted of PDP and PDP panel itself were systematically studied using a thermal desorption technique to understand the origin of the severe outgassing. The characteristics of outgassing were investigated as a function of time and temperature. As the investigated materials, electrode(metal, ITO), dielectric films, barrier rib, fluorescent films, protective layer(MgO), and frit on the glass panel and the multilayer of these materials consisted of PDP panel were used and they were heated up to 500°C. Also, these materials were kept at 350°C for a few hours to measure outgassing characteristics at 350°C which is the temperature used for the exhausting process in the fabrication of PDP. The result showed that the maximum outgassing temperature from the single materials was varied from 100°C to 150°C. Mass spectrometry measurements of the materials maintained at 350°C have shown that the severe outgassing is primarily related the MgO and fluorescent films. These behaviors were compare with outgassing from the complete panel.

FP-TuP6 Characterization of Radio Frequency Magnetron Sputter-deposited Ga@sub 2@O@sub 3@:Mn Phosphors of Thin Film Electroluminescent Display Devices*, J.S. Lewis,* ***J.H. Kim****, P.H. Holloway,* University of Florida

Manganese-activated Ga@sub 2@O@sub 3@ phosphor thin films as the emitting layer of alternating current thin film electroluminescent (ACTFEL) display devices have been prepared by radio frequency (rf) magnetron sputtering of a Mn-doped Ga@sub 2@O@sub 3@ target in a pure argon or an oxygen-argon mixture atmosphere. The structural and compositional properties of the deposited Ga@sub 2@O@sub 3@:Mn phosphor thin films have been systematically investigated as a function of the sputter deposition parameters, such as rf power, working pressure, oxygen gas concentration, and substrate temperature ranging 5 - 50 W, 5 - 30 mTorr, 0 - 50 %, and room temperature - 400 °C, respectively. The surface morphology, structure, and composition of the deposited Ga@sub 2@O@sub 3@:Mn films were characterized by atomic force microscopy (AFM), scanning electron microscopy (SEM), X-ray diffraction (XRD), and energy dispersive X-ray spectroscopy (EDS). Their electroluminescent and photoluminescent characteristics were also evaluated and correlated with the results of the structural and compositional analyses. The ACTFEL display devices were fabricated using the conventional structure, Al/BTO/Ga@sub 2@O@sub 3@:Mn/ATO/ITO/glass, and the inverted structure, ITO/BTO/Ga@sub 2@O@sub 3@:Mn/PZT/Au/Al@sub 2@O@sub 3@.

FP-TuP7 Fabrication of a Microchannel Plate for a FED by Solution-based Multilayer Thin Film Coating*,* ***S. Yu****, T. Jeong, J. Lee, S. Jin, W. Yi, J. Heo, J.M. Kim,* Samsung Advanced Institute of Technology, Korea

To develop a high efficient field emission display (FED), a special microchannel plate (MCP) was incorporated in a FED, where field-emitted electrons are amplified in the cylindrical holes of a MCP by action of secondary electron emission from the emissive layer, and MCP characteristics are examined. We fabricated an alumina-based MCP with many micrometer-sized cylindrical holes by computerized punching and firing of the laminated alumina green sheet, where the aspect ratio of the hole was chosen to be around 13. Solution-based hybrid layer coating was utilized for MCP fabrication. Cu electroless coating was applied to a MCP, then Cu layer was oxidized to be a conductive layer on the surface of the hole. Tetraethyl orthosilicate (TEOS) containing solution was spin coated on the copper oxide layer. Consequent firing resulted in a SiO2 thin layer as an emissive layer. Then electrodes on the two faces of a MCP were deposited by an e-beam evaporator. To optimize the MCP fabrication process, we followed the design of experiment (DOE) scheme. We chose three DOE factors: Cu layer thickness controlled by the Cu electroless coating time (10 and 15 minutes), Cu oxidation temperature (570, 800, and 1030 C), and TEOS concentration (0.015 M and 0.007 M) for SiO2 layer thickness. We measured the current amplifying gain of our MCP by an e-gun. The highest gain was obtained to be about 10 for the sample with 15 min Cu coating time, 1030 C oxidation temperature, and 0.007 M TEOS concentration, where this gain will be beneficial for a new kind of FED by increasing the intensity of cathodoluminescence. Further experiments by varying other experimental factors are undergoing, and good results are expected.

Author Index

Bold page numbers indicate presenter