OLEDs

P.151: Efficient Solution-Processsable Solid-State Light-Emitting Electrochemical Cells Based on Guest-Host Cationic Phosphorescent Complexes

H-C. Su, C-C. Wu, F-C. Fang, K-T. Wong
National Taiwan University, Taipei, Taiwan, ROC

Efficient solution-processable small-molecule and single-layered organic light-emitting devices based on host-guest phosphorescent cationic metal complexes are reported. They show high quantum efficiencies (power efficiencies) of up to 10.4% (36.8 lm/W), representing a promising technique for solution-processable OLEDs.

P.152: Efficient Blue Phosphorescent OLEDs Employing Novel Oligocarbazoles as High-Triplet-Energy Host Materials

M-H. Tsai, Y-H. Hong, C-H. Chang, H-C. Su, C-C. Wu
National Taiwan University, Taipei, Taiwan, ROC

A. Matoliukstyte, J. Simokaitiene, S. Grigalevicius, J. Grazulevicius
Kaunas University of Technology, Kaunas, Lithuania

C-P. Hsu
Academia Sinica, Taipei, Taiwan, ROC

A series of 3(6),9'-linked oligocarbazoles with large triplet energies and morphological stability are reported as host materials for electrophosphorescence. In such oligocarbazoles, the triplet excitation is confined within one carbazole unit, leading to a new molecular design strategy for large-triplet-energy and high morphological stability hosts. Using these hosts, efficient blue phosphorescent OLEDs having efficiencies up to 15%, 31 cd/A, and 28 lm/W were demonstrated.

P.153: Internal Electric-Field Study for Green Phosphorensent Polymer LEDs with Cross-Linked Interlayers

R. Jin, D. D. C. Bradley, J. C. deMello
Imperial College London, London, U.K.

Electroabsorption spectroscopy to measure the internal electric field in green-phosphorescent polymer light-emitting diodes with a crosslinked interlayer between PEDOT:PSS and the emissive layer will be presented. The phenomenon of trapped electrons screening the bulk semiconductor from the external field can explain the efficiency improvement by adding a 5–30-nm MUPD film near the anode.

P.154: Efficient White OLEDs Employing Phosphorescent Sensitization

C-H. Chang, Y-J. Lu, Z-Z. Liu, C-C. Wu
National Taiwan University, Taipei, Taiwan, ROC

Efficient white OLEDs employing phosphorescent sensitization were investigated. Devices with a single phosphor-sensitized emitting layer can give colors close to (0.33, 0.33) and efficiencies up to 10%, 23 cd/A, and 13.4 lm/W. Devices with a sensitized emitting layer and a low-concentration phosphorescent layer further enhance the efficiencies up to 12.1%, 35.3 cd/A, and 23.9 lm/W. In all phosphor-sensitized WOLEDs, the efficiency roll-off at higher currents is greatly reduced.

P.155: Ambient Contrast for OLED Displays

R. Cok, A.D. Arnold
Eastman Kodak Co., Rochester, NY, U.S.A.

OLED devices typically include a back electrode that reflects both emitted and incident ambient light. The reflected ambient light reduces the contrast ratio of OLED displays, reducing the visibility and image quality of the display. A variety of techniques for improving OLED ambient contrast will be described, and measurements of their effectiveness discussed together with any impact on other OLED performance characteristics will be reported.

P.156: Polymeric Electrophosphorescent Devices with Low Turn-On Voltage and High Power Efficiency by Blending with Poly(ethylene glycol)

S-C. Chien, F-C. Chen
National Chiao Tung University, Hsinchu, Taiwan, ROC

By blending poly(ethylene glyol) into the active layer of green electrosphosphorescent devices, the luminance efficiency of the device with Al cathode achieves to almost 16 cd/A. Furthermore, the turn-on and driving voltage of the device were also decreased. Consequently, higher power conversion efficiency can be achieved by this simple method.

P.157: Electrical Modeling and Numerical Simulation of Doped Multilayer OLEDs

C. Pinot, H. Cloarec, T. Maindron, D. Vaufrey, C. Prat, H. Doyeux, J.-C. Martinez,G. Haas
Thomson R&D France, Cesson Sévigné, France

Y. Bonnassieux
Ecole Polytechnique, Palaiseau, France

The influence of dye doping, electrical doping, and space-charge effects on charge-carrier transport at different operating temperatures will be predicted and explained. For that purpose, current–voltage J–V characteristics for typical electrically doped multilayered devices have been simulated. The results are in good agreement with experiment.

P.158: Highly Efficient Excipex-Emitting White OLED Based on Complementary Emitters

Y-M. Kim
Korea University, Seoul, Korea and Samsung Electronics Co., Ltd., Kyunggi-do , Korea

Y-W. Park, J-H. Choi, J-W. Huh, B-K. Ju
Korea University, Seoul, Korea

J-H. Jung
Samsung Electronics Co. Ltd., Kyunggi-do, Korea

J-K. Kim
Korea Institute of Science and Technology, Seoul, Korea

White organic light-emitting diodes (OLEDs), which have two emitters with similar structures (1, 1, 4, 4-tetraphenyl-1, 3-butadiene, and 2,9-dimethyl-4,7-diphenyl-1,10- phenanthroline) with an emission peak at 400 nm around the near-ultraviolet, and tris-(8- hydroxyquinoline) aluminum doped with 4-(dicyanomethylene)-2-methyl-6-(pdimethylaminostyryl)-4H-pyran with an emission peak at 580 nm producing a yellow color, was demonstrated. The EL spectra of the white OLED have shown a covering through the visual range from 400 to 780 nm by exciplex emission, and the CIE coordinate of the white OLED was (0.33, 0.34) with a low driving current density (10.8 mA/cm^2) and high efficiency (12 cd/A, 2 lm/W) at 1 000 cd/m^2.

P.159: Efficient Red Electrophosphorescent Devices Based on Inter-Ligand Energy Transfer of Heteroleptic Tris-Cyclo-Metalated Iridium Complexes

J. H. Seo, G. Y. Park, Y. S. Kim, Y. K. Kim
Hongik University, Seoul, Korea

Y-H. Kim, W. Y. Kim
Hoseo University, Asan, Korea

Red heteroleptic tris-cyclometalated iridium complex, $Ir(ppy)_2(dpq\text{-}3\text{-}F)$, have been characterized. When $Ir(ppy)_2(dpq\text{-}3\text{-}F)$ is placed in the excited state, the excitation energy is quickly intramolecular transferred from two ppy to one luminescent dpq-3-F. Thus, $Ir(ppy)_2(dpq\text{-}3\text{-}F)$ shows emission at 620 nm from dpq-3-F. The device with $Ir(ppy)_2(dpq\text{-}3\text{-}F)$ showed superior electrical characteristics by decreasing self-quenching.

P.160: White OLED Diode Based on Single White Dopant of Heteroleptic Tris-Cyclometalated Iridium(III) Complex

J. H. Seo, Y. H. Lee, Y. S. Kim, Y. K. Kim
Hongik University, Seoul, Korea

Y-H. Kim, W. Y. Kim
Hoseo University, Asan, Korea

A white organic electroluminescent device based on a single white dopant, $Ir(dfppy)_2(pq)$, was reported. The similar phosphorescent lifetime of two ligands lead to emittance luminescence in two ligands at the same time, the emission wavelength of a single white dopant has a broad peak and emits white color without intramolecular energy transfer.

P.161: WITHDRAWN

P.162: Recycling Surface Plasmon Polaritons of OLED for Tunable Double Emission and Efficiency Enhancement

K-C. Tien, C-C. Wu
National Taiwan University, Taipei, Taiwan, ROC

By thinning the metal electrode, the SPP modes of OLEDs can be coupled to the outside surface of the device, where they can be recycled for external emission by simply capping the device with an appropriate absorbing/re-emission medium. A modest efficiency enhancement has been observed. In addition, such an approach provides double-emitting OLEDs with a wide-range color-tuning capability, which may be of use for some applications.

P.163: Polymer Electrode and Micro-Patterning Using PEDOT and Its Organic Display Applications

J-Y. Kim, M-H. Kwon, J-T. Kim, J-H. Lee, S. Kwon
Kookmin University, Seoul, Korea

Conductive ultra-thin films of PEDOT are prepared using depositing polymerization in the gas phase. Also investigated was the selective growth of self-assembled PEDOT layers on patterned oxidant formed by a micro-contact-printing method. The conductive nano-films have high transparency (up to 80%) and low sheet resistance (down to 100 Ω/sq.). Applications include organic films used in devices such as EL and touch screens.

P.164: Highly Efficient White OLEDs Using Two Emitting Materials for Three Primary Colors (Red, Green, and Blue)

J. H. Seo, J. H. Kim, G. W. Hyung, J. H. Park, Y. K. Kim
Hongik University, Seoul, Korea

K. H. Lee, S. S. Yoon
Sungkyunkwan University, Suwon, Korea

W. Y. Kim
Hoseo University, Asan, Korea

Multi-emissive-layered white organic light-emitting diodes (WOLEDs) were fabricated with a red phosphorescent and a blue fluorescent material. The two emissive materials emitted a white color as a mixture of the three primary lights (red, green, and blue). One device had a maximum luminance of 30,500 cd/m^2 at 14 V and a luminous efficiency of 38.0 cd/A at low current. Another device also had Commission Internationale de L'Eclairage (CIE) coordinates of (x = 0.36, y = 0.35) at 10 V, which is a perfect white emission. The emission characteristics of WOLEDs were investigated, and the emission mechanism will also be discussed.

P.165: Wet-Processible Triphenylamine Dendrimers as Hole-Transporting and Hole-Injection Materials for Organic Light-Emitting Devices

M. Ichikawa, K. Hibino, T. Koyama, Y. Taniguchi
Shinshu University, Nagano, Japan

N. Yokoyama, T. Miki
Hodogaya Chemical Co., Ltd., Ibaraki, Japan

Two solution-processable triphenylamine dendric nonamers, the N-atom-centered nonamer (TPA9-1) and the phenyl-centered nonamer (TPA9-2), were demonstrated. The materials were found to have high-glass-transition temperature (T_g) up to almost 200°C. The fractional difference of the central units of the molecular structures caused different adaptability due to the different ionization potentials (Ip). TPA9-1 (N-atom-centered), whose I_p was smaller than that of TPA9-2 (phenyl-centered), was suitable as hole-injection layer material, and TPA9-2 was suitable as hole-transporting-layer material. Computational chemistry provides a ready explanation for the I_p difference between the two materials.

P.166: Highly Efficient Organic Light-Emitting Devices with Double Interfacial Layers

J-H. Park, S-S. Oh, S-W. Kim, E-H. Choi, B-H. Hong, Y-H. Seo, G-S. Cho
Kwangwoon University, Seoul, Japan

B. Park
Korea Research Institute of Chemical Technology, Daejon, Korea

Highly efficient phosphorescent organic light-emitting devices achieved by introducing nanoscale double interfacial layers are reported. The double interfacial layers play multiple roles in the enhancement of device performance, increasing electron injection, hole blocking, and preventing luminescence quenching at the electrode surface. As an experimental result, the current efficiency was improved to 240%, yielding a peak brightness of over 40,000 cd/m^2 and a peak efficiency of more than 60 cd/A.

P.167: High-Color-Temperature p-i-n White Organic Light-Emitting Devices Based on the Fluorescent RGB System

C-J. Chen, S-W. Hwang, C.H. Chen
National Chiao Tung University, Hsinchu, Taiwan, ROC

P-i-n devices with 5% Cs-doped BPhen as the n-type transporting layer and WO_3-doped NPB as the p-type transporting layer were investigated to control the recombination zone (RZ) of carriers in WOLEDs, which is based on three adjacent fluorescent red, green, and blue emitters. The variation in white CIEx,y color coordinates were found to be closely related to the portion of deep-blue emission, which serves as an indicator for the position of the RZ. The latter can be controlled by adjusting the ratio of Alq_3/BPhen and by optimizing the concentration of the deep-blue dopant to enhance the EL performance and color temperature of WOLEDs, which boosts efficiency to 8 cd/A at 5.5 V (20 mA/cm^2) with CIEx,y of (0.33, 0.34) that is among the best reported for the fluorescent RGB 3-emission WOLEDs.

P.168: Investigation of High-Efficiency Electrophosphorescent OLEDs with Double-Emission Layers

J. X. Sun, X. L. Zhu, X. M. Yu, M. Wong, H. S. Kwok
Hong Kong University of Science and Technology, Kowloon, Hong Kong

Highly efficient electrophosphorescent organic light-emitting diodes (PHOLEDs) with double-emission layers by doping both hole- and electron-transport hosts with green-dye bis(2-phenylpyridine)iridium(III)acetylacetonate [(ppy)2Ir(acac)] have been fabricated and investigated. In particular, the dependence of performance characteristics on the thickness and doping concentration of the double-emission layers was studied. By fine tuning these two parameters, a peak luminous efficiency of 77 cd/A, corresponding to 20.5% external quantum efficiency (EQE), was achieved at a current density of 0.053 mA/cm^2 from the optimized device. Even at 1000 cd/m^2, it still shows a very high luminous efficiency of 71 cd/A together with a power efficiency of 40 lm/W. A shifting exciton formation zone with a driving current as well as triplet-triplet annihilation was used for explaining the efficiency profile observed experimentally.

P.169: Efficient, Long-Lifetime OLED Host and Dopant Formulations for Full-Color Displays

M. L. Ricks, J. R. Vargas, K. P. Klubeck, V. V. Jarikov, L-S. Liao, M. J. Helber, W. J. Begley, T. K. Hatwar
Eastman Kodak Co., Rochester, NY, U.S.A.

S. R. Conley
Todd LLC, Cincinnati, OH, U.S.A.

L. Cosimbescu
Rochester, NY

C. T. Brown
Plextronics, Inc., Pittsburgh, PA, U.S.A.

Developments in the materials and formulations for blue, green, and red fluorescent OLEDs that provide lifetimes exceeding 15,000 hours for a model display operating at 200 cd/m^2 with a polarizer will be reported. Improvements in electron transport and injection provide a significant reduction in display power consumption of up to 55%.

P.170: Decomposable Alkali Compounds as Alkali Metal Precursors for Organic LEDs

L. Duan, Y. Li, Y. Qiu
Tsinghua University, Beijing, China

Electron injection in organic light-emitting diodes (OLEDs) can be improved by the incorporation of alkali metals into the cathode structures. Some of the alkali compounds, such as alkali carbonates and nitrides, would decompose to form alkali metal during vacuum thermal evaporation. These materials can be incorporated into cathode structures to improve OLED performance. An improved quartz-crystal microbalance method to quantitatively investigate the decomposition of these alkali compounds in situ has been developed. Cs_2CO_3 and Li_3N were found to be ideal alkali metal precursors for OLEDs.

P.171: High-Efficiency Low-Voltage Phosphorescent OLED Devices with Mixed Host

M. E. Kondakova, J. C. Deaton, D. Y. Kondakov,
T. D. Pawlik, R. H. Young, C. T. Brown, D. J. Giesen
Eastman Kodak Co., Rochester, NY, U.S.A.

High-efficiency low-voltage phosphorescent OLED devices (PHOLEDs) using mixed host materials in the light-emitting layer (LEL) and novel formulations in the electron-transporting/electron-injecting layers (ETL/EIL) were demonstrated. The LEL architecture offers significant improvement in efficiency and voltage compared to that of conventional phosphorescent OLEDs with carbazole-based hosts. Further voltage reduction in PHOLEDs was achieved through the use of a novel material formulation in the ETL and EIL.

P.172: Determination of Hole Mobilities in New Blue-Emitting Organic Diodes by Means of Impedance Spectroscopy

B. Arredondo, B. Romero, A.L. Alvarez,
A. Gutierrez-Llorente, X. Quintana, R. Mallavia, R. Vergaz,
F. Montilla, J. M. Sanchez-Pena, J. M. Oton
Universidad Rey Juan Carlos, Mostoles, Spain

A passive diode matrix based on a new blue-emitting organic electroluminescent diode has been fabricated. In order to determine the capacitive response at the operating frequencies, impedance vs. frequency measurements have been carried out at different bias. In addition, relevant transport properties as hole mobilities have been extracted by fitting a theoretical model to the measured admittance, obtaining values ranging from 10^{13} to10^{-8} m^2/V-sec, depending on bias.

P.173: Reduction of Shorting Defects in OLED Devices

Y-S. Tyan, G. Farruggia, T. Cushman
Eastman Kodak Co., Rochester, NY, U.S.A.

A method to reduce the detrimental effect of shorting defects in OLED devices will be presented. The method involves the application of a transparent thin film of appropriate electrical resistance between the two electrodes in order to divert the current away from the shorting defects.

P.174: Triplet Exciton Diffusion in Hybrid Fluorescent OLEDS/ POLEDs

J. C. Deaton, M. E. Kondakova, D. Y. Kondakov, T. D. Pawlik, D. J. Giesen
Eastman Kodak Co., Rochester, NY, U.S.A.

A hybrid OLED comprising blue fluorescent and red phosphorescent emitters is reported. External quantum efficiencies for the blue and the red components of the electroluminescence along with time-resolved measurements, magnetic-field effect, and ED-EPR experiments suggest that the recombination occurs in the blue emissive layer, producing fluorescence with the singlet excitons, while the triplet excitons are utilized upon migration to the red layer.

P.175: Enhanced Outcoupling of Light from OLEDs by Microlens Arrays Based on Breath-Figure Templates

K. Chari, C. W. Lander, J-S. Wang, D. M. Preuss
Eastman Kodak Co., Rochester, NY, U.S.A.

A bottom-up method of fabricating microlens arrays based on a template of close-packed microvoids created by self-assembly and subsequent evaporation of condensed water droplets on the surface of a polymer solution exposed to humid air will be presented. The pattern of microvoids is transferred to an optically transparent, thermally curable elastomer to form the microlens array. The method offers advantages over conventional top-down microfabrication approaches in terms of easy fabrication, high fill factor, and near-optimum shape of the microlenses. Attachment of the microlens array to the glass substrate of an OLED device results in a significant increase in total emission and external quantum efficiency.

P.176: Progress in Developing High-Efficiency Quantum-Dot Displays

S. Coe-Sullivan, P. Kazlas, J. Steckel, M. Cox, C. Roush, D. Ramprasad, C. Breen, J. Ritter
QD Vision, Inc., Watertown, MA, U.S.A.

LED displays utilizing quantum dots (QDs) as emitters offer several key advantages over more traditional OLEDs, combining the solution processability of polymers with the high-efficiency potential of phosphors, all with the stability benefits of an inorganic emitter. While QD-LEDs are at an early stage in their development, the commercialization effort has already led to the identification of several considerations particular to QD-LEDs. Material and design considerations for QD-LEDs will be explored, emphasizing areas in which they differ from OLEDs, and some approaches to improve the performance of hybrid organic-inorganic QD-LEDs will be introduced. The impact of these approaches will be presented along with an update on the state of the art in QD-LED performance.

P.177: Characterization of Orange OLED Stack for Bidirectional Active-Matrix OLED Microdisplays

D. Kreye, M. Toerker, B. Richter, U. Vogel, J. Amelung, T. Sonnabend
Fraunhofer Institute for Photonic Microsystems, Dresden, Germany

An orange-emitting phosphorescent OLED stack with doped charge-transport layers was prepared on different types of CMOS substrates. First, OLED deposition was performed on a single-diode 6-in. wafer substrate, and afterwards on a micro-structured two-metal-layered CMOS tests substrate without an active transistor area. The different test substrates were measured and compared with respect to their performance (current, luminance, voltage, luminance dependence on viewing angle, optical outcoupling, *etc.*).

P.178: High-Efficiency and Long-Lifetime Phosphorescent OLED Devices Based on Electron-Trapping Ir (III) complexes

X. Ren, R. H. Young, S. Huo, D. J. Giesen, M. Rajeswaran, J. C. Deaton
Eastman Kodak Co., Rochester, NY, U.S.A.

New iridium (III) complexes having coumarin, including its aza-analog structure in their ligands, have been developed. These Ir complexes are highly emissive with colors ranging from yellow, yellowish-green, and green to bluish-green. Electrochemical analysis shows that the reduction and oxidation potentials of these complexes occur at significantly less negative and more positive potentials, respectively, than are found for typical Ir(III) complexes in OLEDs, indicating these complexes are electron-trapping instead of hole-trapping. Long-lived phosphorescent OLEDs fabricated with these new Ir complexes give external quantum efficiencies and power efficiencies above 18% and 33 lm/W, respectively.

P.179: Low-Blur Effect and High-Light-Extraction Efficiency Enhancement of OLEDs with Novel Microstructure Attachment

C-Y. Lin, S-C. Hsu, K-Y. Chen, H-Y. Lin, J-H. Lee
National Taiwan University, Taipei, Taiwan, ROC

M-K. Wei
National Dong Hwa University, Hualien, Taiwan, ROC

Microstructure-film-attachment and surface-roughing techniques had long been utilized to improve the light extraction efficiency from a light source with a high refractive index. Instead of merely concerning the efficiency for lighting purposes, both the light extraction efficiency and image quality were taken into account for display applications. The image blur was observed to decrease the contrast ratio and thus lower image quality. In a previous paper, the image blur effect was quantitatively studied and correlated to the coverage ratio and light extraction efficiency. In this paper, an innovative microstructure array arrangement was applied to a planar light-emitting device, *i.e.*, for an organic light-emitting display (OLED), to reduce the blur effect, and to keep almost the same efficiency as that obtained by applying a traditional microstructure array.

P.180: High-Efficiency Tandem White Organic Light-Emitting Devices

P-C. Yeh, J-W. Ma, S-W. Hwang, M-H. Ho, S-F. Hsu, C.H. Chen
National Chiao Tung University, Hsinchu, Taiwan, ROC

Efficient integrated tandem two-unit p-i-n white organic light-emitting diodes (WOLEDs) with a transparent NPB:WO_3 interconnecting layer was demonstrated. The CIEx,y, luminance yield and EQE of the tandem OLEDs (at 20 mA/cm^2) were (0.27,0.40), 16.7 cd/A, and 6.47% compared to single-unit OLEDs with (0.32,0.43), 9.86 cd/A, and 3.61%, respectively. The CIEx,y coordinates of the tandem OLEDs revealed little change (Δx,y <0.01) from a brightness of 200–4000 cd/m^2 and (Δx,y <0.03) from a forward viewing angle of ±60°. This performance of tandem WOLED represents considerable improvement over what have been known in the literature.

P.181: Solution-Processible White PLED Materials for Displays and Lighting

T. Pounds, R. J. Wilson, I. Grizzi
CDT Oxford, Ltd., Cambridge, U.K.

T. Yamada
Sumitomo Chemical Co. Ltd., Tsukuba, Japan

Solution-processable materials are important in the fabrication of low-cost displays and lighting. The development of state-of-the-art white polymer-LED materials with a long lifetime, high color-rendering index, and good color stability over the operating lifetime will be presented.

P.182: New Deep-Blue EML Materials Based on Fully Substituted Ethylene and Anthracene Derivatives

S-K. Kim, J-W. Park
Catholic University of Korea, Pucheon, Korea

K-S. Kim, S-D. Lee, S-W. Kim
Doosan Corp., Yongin, Korea

New blue fluorescent compounds containing tetra-substituted ethylene moieties have been designed and synthesized. By fabricating multilayered non-doped OLED devices using these new blue materials, luminance efficiencies of 4.00 lm/W (10.33 cd/A at 8.1 V) for BPBAPE[CB-104] and 1.82 lm/W (3.93 cd/A at 6.8 V) for BTPPA [CB-105B] at 10 mA/cm^2 were achieved. The BPBAPE [CB-104] and BTPPA [CB-105B] devices exhibited sky-blue emission (0.195, 0.303) and deep-blue emission (0.159, 0.135) at 10 mA/cm^2, respectively. New types of blue materials, such as CB-201, 202, and 203, were also synthesized. The CB-203 device showed a 3.11-cd/A current efficiency and a (0.148, 0.088) CIE value.

P.183: Efficient Deep-Blue, Blue, Green, Yellow, Reddish-Orange, and Red-Organic Light-Emitting Device Using 2,7-Dipyrene-Spirofluorene(DPSF) as an Fluorescent-Emitting Host

F-W. Yen, C-Y. Chiu, I-F. Lin, C-M. Teng, X-H. Lin
Luminescence Technology Corp., Hsinchu, Taiwan, ROC

Deep-blue, blue, green, yellow, and reddish-orange organic light-emitting devices have been fabricated using the same emitting host – 2,7-dipyrene-spirofluorene(DPSF). By using Alq_3 and DPSF as co-hosts to optimize the reddish-orange device, a CIE coordinate of [0.65, 0.35] for saturated red and a current efficiency of 4.9 cd/A were obtained at 20 mA /cm^2. The studies of HOMO/LUMO energy levels, fluorescent exciting energy transfer from DPSF to all gusts (PL and UV), and the mobility of materials interpret DPSF as extensively used as the emitting host at full wavelength for organic light-emitting devices (OLEDs).

P.184: A High-Efficiency Bilayered Red-Phosphorescent OLED

J-H. Kwon, T-J. Park, W-S. Jeon, Y-K. Lee, S-H. Jeong, J-J. Park, J. Jang
Kyung Hee University, Seoul, Korea

A high-efficiency red-phosphorescent OLED (PHOLED) with an organic bilayered structure is reported. The structure of bilayered red PHOLEDs was ITO/ N,N`-di(naphthalene-1-yl)-N,N`-diphenyl-benzidine (NPB)/new host: $Ir(piq)_3$/LiF/Al. A high current efficiency of 10.0 cd/A and a power efficiency of 7.8 lm/W at 500 cd/m^2 were demonstrated in this device. The operational driving voltage required to reach 1000 cd/m^2 was 4.5 V and the CIE coordinate was (0.67, 033). This bilayered PHOLED fabricated by a new phosphorescent host material resulted in about three times the enhancement of power efficiency compared with that of a CBP-based control device.

P.185: High-Efficiency Solution-Processed Red-P-OLEDs Based on a Soluble Small-Molecule Host with an $Ir(piq)_3$ Complex

S-H. Jeong, T-J. Park, W-S. Jeon, J-J. Park, Y-K. Lee, J-H. Kwon, J. Jang
Kyung Hee University, Seoul, Korea

It was demonstrated that solution-processed high-efficiency and saturated red-phosphorescent OLEDs could be achieved by using a soluble small molecule (SSM) as the host material. Two structures of ITO/PEDOT/interlayer/SSM:$Ir(piq)_3$/LiF/Al and ITO/PEDOT/interlayer/SSM:$Ir(piq)_3$/sublimated Balq/sublimated Alq_3/LiF/Al were employed as all-soluble-processed devices and hybrid devices, respectively. A maximum luminance efficiency of 6.36 cd/A and a maximum power efficiency 3.22 lm/W were obtained in a hybrid device. The CIE coordinate was (0.67, 0.33).

P.186: OLEDs Integrated with Solar Cells: High Contrast and Energy Recycling

C-J. Yang, T. Y. Cho, C-Ch. Wu
National Taiwan University, Taoyuan, Taiwan, ROC

By integrating OLEDs with solar cells, ambient-light reflection as low as 1.4% (even superior to that achieved with polarizers) can be achieved without compromising the EL efficiency for high-contrast display applications. Furthermore, in such a device, the incident photon energy and a portion of the OLED emission that does not get outside of the device can be recycled by conversion to electrical power. These features make this technique attractive for high-contrast-display applications and portable/mobile electronics that are power aware.

P.191: Novel Bipolar Materials Tailored for Phosphorescent OLEDs

S.Yamagata, H. Murata, M. Egawa, H. Nakashima, H. Inoue, S. Shitagaki, N. Ohsawa, K. Kojima, S. Seo, R. Nomura, S. Yamazaki
Semiconductor Energy Laboratory Co., Ltd ., Kanagawa, Japan

Novel bipolar materials suitable for acting as host materials of phosphorescent organic light-emitting diodes (OLEDs) were synthesized. The molecular design strategy involves combining electron- and hole-transporting components to produce a well-balanced transportability, which contributes to an increase in efficiency and a decrease in operation voltage of green- and red-phosphorescent OLEDs.