Abstract

Organic light emitting diodes (OLEDs) are the future of solid state light and display. However, the efficiency, lifetime and production method still need to be improved. Recently, small molecules OLEDs (SMOLED) are fabricated using thermal evaporation method which is complicated and expensive. In order to solve the problem, this thesis presents a solution processing method for SMOLED fabrication. A robust technique of spin coating has been used to produce SMOLED and the SMOLED were prepared and characterized in room environment. Alq_3 has been selected as a main material in this work. The device shows the highest luminance and current efficiency of 8 cd/m^2 and 1.1 cd/A, respectively. The performance of the device is improved by doping Alq_3 with an organic blend. *N,N'*-diphenyl-*N,N'*-bis(3-methylphenyl)-1,1'-biphenyl-4,4'-diamine (TPD) hole-transporting material (HTM) and 2-(4-biphenylyl)-5-phenyl-1,3,4-oxadiazole (PBD) electron-transporting material (ETM) were used as organic dopant materials. Significant improvement in the performance of the device was achieved for TPD:PBD:Alq_3 blend device with a maximum luminance and a current efficiency of 346 cd/m^2 and 2.7 cd/A, respectively. The luminance is more than 40 times brighter than Alq_3 OLED device. The turn on voltage of the device also reduces from 10 (pure Alq_3) to 5V (blend OLED). The optimization of TPD:PBD:Alq_3 blend OLED was performed by a simple annealing process. The best performance of the blend OLED was obtained for the device annealed at 100^{o}C for 10 minutes, with a maximum luminance and current efficiency of 680 cd/m^2 and 3.6 cd/A, respectively. Major contribution of this research is the development of a new formula, novel blends to enhance the efficiency of single layer OLEDs. Future work can be focused on the blend ratio and the annealing temperature which are expected to produce a variety of color emission and high efficient device.

Abstrak

Organik diod pemancar cahaya (OLEDs) adalah masa depan cahaya keadaan pepejal dan paparan. Walau bagaimanapun, kecekapan, jangka hayat dan kaedah pengeluarannya masih perlu dipertingkatkan. Pada masa ini, molekul tunggal OLED (SMOLED) difabrikasikan melalui kaedah penyejatan termal yang rumit dan mahal. Untuk menyelesaikan masalah tersebut, tesis ini membentangkan kaedah pemprosesan berasaskan larutan untuk fabrikasi SMOLED. Teknik adunan telah digunakan untuk menghasilkan SMOLED dan SMOLED ini telah disediakan dan dicirikan dalam persekitaran bilik. Alq_3 telah dipilih sebagai bahan utama dalam kajian ini. Peranti menunjukkan keamatan cahaya tertinggi dan kecekapan arus pada 8 cd/m^2 dan 1.1 cd/A, masing-masing. Prestasi peranti bertambah baik dengan mengadunkan Alq_3 dengan campuran organik. N, N'-Diphenyl-N, N'-bis (3-methylphenyl) -1,1 '-terpoliklorin-4, 4'-diamine (TPD), bahan pengalir cas positif (HTM) dan 2 - (4-biphenylyl) -5-phenyl-1,3,4-oxadiazole (PBD), bahan pengalir elektron (ETM) telah digunakan sebagai bahan adunan organik. Peningkatan yang ketara dalam prestasi peranti telah dicapai untuk peranti TPD:PBD:Alq_3 dengan keamatan cahaya dan kecekapan arus ialah 346 cd/m^2 dan 2.7 cd/A, masing-masing. Keamatan cahaya ini adalah 40 kali lebih cerah daripada peranti Alq3 OLED. Voltan-hidup peranti juga berkurangan daripada 10 (Alq_3) kepada 5V (OLED teradun). Pengoptimuman OLED TPD:PBD:Alq_3 dilakukan melalui proses pemanasan. Prestasi terbaik OLED teradun telah diperolehi bagi peranti yang dipanaskan pada suhu 100^oC selama 10 minit, dengan keamatan cahaya dan kecekapan arus sebanyak 680 cd/m^2 dan 3.6 cd/A, masing-masing. Sumbangan utama kajian ini adalah pembangunan adunan baru untuk meningkatkan kecekapan OLED berlapisan tunggal. Pada masa depan, tumpuan diberi kepada nisbah adunan dan suhu pemanasan yang dijangkakan dapat menghasilkan peranti yang mempunyai pelbagai warna cahaya dan berkecekapan tinggi.