摘要

本論文討論一些新穎螢光材料之光物理、熱穩定性、電化學性質及電激發光特性。我們將這些具功能性的材料分為四類，(一)、含quinoxaline及arylamine之螢光材料(**QuPy**)：此類雙極化分子：具很好的熱穩定性(T_d > 400 °C)，其放光光色由綠至橘紅，亦具有溶劑效應。材料製成下列兩種雙層式元件：(I) ITO/**QuPy**/Alq_3/Mg:Ag；(II) ITO/**QuPy**/TPBI/ Mg:Ag；元件之電激發光與固態膜螢光吻合，激發光子之再結合區侷限在**QuPy**層，光色由綠至橘紅。(二)、含dibenzothiophene及arylamine之螢光材料(**S1-S6**)：此類非晶形化合物之T_g值介於86-190 °C，放光由藍至藍綠色。將材料製成下列兩種雙層式元件：(I) ITO/**S1-S6**/TPBI/LiF/Al；(II) ITO/**S1-S6**/Alq_3/LiF/Al；元件(I)之光色由純藍至藍綠，元件(II)則將Alq_3之發光效率大幅提升。(三)、含dibenzothiophene-*S*,*S*-dioxide及arylamine之螢光材料(**SO**)：此類雙極化分子具溶劑效應，放光由藍色至綠色；化合物之非晶相T_g值介於 102-138 °C。以**SO2** 製成的單層元件：ITO/**SO2**/LiF/Al，有很好的發光效率，其電子與電洞遷移率幾近相當。(四)、含dibenzothiophene/oxide及quinoxaline/pyrazine之螢光材料(**DQ**)：化合物的非晶相T_g值介於 132-194 °C。以**DQ**為電子傳輸材料的元件：(I) ITO/Qn/**DQ**/LiF/Al；(II) ITO/Qn/**DQ**/LiF/Al (Qn = 2,3-bis[4-(*N*-phenyl-9-ethyl-3-carbazolyl-amino)-phenyl]-quinoxaline)有不錯的電激發光效率；我們並以時間飛逝法測量材料之電子及電洞遷移率。

Abstract

The synthesis, optical, thermal, electrical and electroluminescent properties of some novel organic electroluminescent materials are reported in this thesis. These functional materials were divided into four classes. Class 1. Quinoxalines incprporating arylamine (**QuPy**): These dipolar compounds possess high thermal decomposition temperature (T_d > 400 °C). The emission color of these materials varies from green to orange red. Two types of organic light-emitting diodes (LED) were fabricated. : (I) ITO/**QuPy**/Alq_3/Mg:Ag; (II) ITO/**QuPy**/TPBI/Mg:Ag. The recombination zone in most of those devices was confined in quinoxaline segments which emits green to orange colors and corresponds well with the film PL of the material used. Class 2. Dibenzothiophene incprporating arylamine (**S1**-**S6**): These dibenzothiophene derivatives are amorphous and their T_gs range from 86 to 190 ^oC. They are fluorescent and emit in the blue to bluish green region. Two types of devices were fabricated. (I) ITO/**S1**-**S6**/TPBI/LiF/Al ; (II) ITO/**S1**-**S6**/Alq_3/LiF/Al. Several type I devices emit pure blue light, and most of the devices II have very promising performance. The relation between the energy levels of the materials and the performance of the light-emitting diodes is discussed. Class 3. Dibenzothiophene-*S*,*S*-dioxide incprporating arylamine (**SO**): These dipolar compounds emit light in blue to green region. They readily form glass with glass transition temperatures ranging from 102 to 138 ^oC. High performance single-layer green-emitting device was fabricated: ITO/**SO2**/LiF/Al. The hole and electron mobility measured by TOF method were comparable ($\mu \sim 10^{-4}$ $cm^2/(V \cdot s)$). Class 4.

Dibenzothiophene/oxide- incprporating quinoxaline/pyrazine (**DQ**): These new materials are amorphous with a glass transition temperature ranging from 132 to 194 ^{o}C. The TOF measurement indicated that these compounds are electron transporting (mobility = 2-5 x 10^{-4} $cm^2/(V \cdot s)$). Two types of double-layer devices fabricated, (I) ITO/Qn/**DQ**/LiF/Al ; (II) ITO/Qn/**DQ**/LiF/Al (Qn = 2,3-bis[4-(*N*-phenyl-9-ethyl-3-carbazolyl-amino)phenyl]-quinoxaline), were found to exhibit good performance.