博 士 論 文 の 内 容 の 要 旨

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論文題目	**Study on development of novel materials for organic light-emitting diodes based on hole conducting substituents and their device application**（ホール伝導性置換基を用いた新規 OLED 材料の開発及びデバイス応用に関する研究）

Organic light-emitting diods (OLEDs) has the characteristics of low driving voltage, high brightness, wide viewing angle, fast response speed and simple manufacturing process. It is known as the new generation of flat panel display technology, especially in the field of solid-state lighting and small and medium size display. At present, the key problems hindering large-scale marketization are low luminous efficiency, short lifetime and poor performance stability. Therefore, further development of high efficiency and long lifetime electroluminescent materials is still the main goal of current and future research work. In this paper, a series of novel electron blocking materials, phosphorescent host materials and capping layer materials are studied, and a series of materials are designed and synthesized, and their devices performance is characterized; further, the preparation of high efficiency top light-emitting diods is also studied. The following is a brief introduction to the main contents of each chapter:

1. In the first chapter, the material history and development status of OLEDs are introduced. In this paper, the new hole-transport type materials are reviewed from the aspects of material application direction and molecular structure characteristics. And the main research contents of this paper are summarized.

2. In the second chapter, we synthesized BFS2A, BFS3A, SF2DDA and SF4DDA , and applied them as electron blocking materials in OLEDs. Among them, the core of BFS2A and BFS3A is cyclo-spiro structure, and the core of SF2DDA and SF4DDA is spirofluorene. When the film thickness of BFS2A and BFS3A is 50nm and the current density is 10mA cm^{-2}, the maximum current efficiency of BFS2A and BFS3A are 10.46 cd A^{-1} and 9.26 cd A^{-1}, respectively, and the lifetime (LT90) is 1592 hours and 1805 hours respectively. When the film thickness of SF2DDA and SF4DDA is 20nm and the current density is 10mA cm^{-2}, the maximum current efficiency of SF2DDA and SF4DDA are 9.81 cd A^{-1} and 10.00 cd A^{-1}, respectively, and the lifetime (LT90) is 430.46 hours and 420 hours, respectively. The experimental results show that compared with the traditional electronic blocking materials SF2AF and SF4AF, the above compounds can effectively improve the device efficiency and lifetime.

3. In the third chapter, we synthesized DFBDDba，BDFPDbA and BDFPDcA by changing the structure

of dimethyl-dihydrobenzofuran as the basic unit, and applied them as electron blocking materials in OLEDs. These materials exhibit excellent photophysics properties and thermal stability, and have high triplet energy levels, which can effectively improve the external quantum efficiency and lifetime of devices. At 10 mA cm^{-2}, the external quantum effciency (EQE) of the device based on DFBDDba reaches 7.15%, and the lifetime of the device reaches 277 hours (LT90), which is 8 times longer than that of the device based on TCTA. The experimental results show that compared with the traditional electronic blocking material TCTA, the above compounds can effectively improve the device efficiency and lifetime.

4. In Chapter 4, we synthesized XanCarDipha, p-XanCarDipha and m-XanCarDipha by changing the branched chain structure of Xanthone, which were used as host materials in green phosphorescent OLEDs. Due to the difference of the connection mode between carbazole unit and Xanthone, the compounds have different photophysical properties and device performance. The glass transition temperature of the compound is higher than 120 ℃, which indicates that the compound has good thermal stability. As a single host green phosphorescent device, p-XanCarDipha has a maximum current efficiency of 62.55 cd A^{-1} and a maximum power efficiency of 42.60 lm W^{-1}. Furthermore, the maximum external quantum efficiency, current efficiency and power efficiency of p-XanCarDipha: cartria(double host) are 20.93%, 77.40 cd A^{-1} and 93.15 lm W^{-1}, respectively. Compared with the single host device, the device efficiency of the double host device is significantly improved.

5. In Chapter 5, we synthesized CPL-1 and CPL-2 with triazine structure as the basic unit by changing the branched chain structure, and applied them as capping layer materials in top light-emitting diods. Compared with CPL-ref, the device efficiency of CPL-1 and CPL-2 is improved by 3.4% and 9.1%, and they have higher luminous brightness and smaller color deviation in the 0~75°viewing angle range because of the higher refractive index(n) and lower extinction coefficient(K).

Key words: Electron blocking layer; cyclo-spiro ； Dimethyl-dihydrobenzofuran ； Xanthone ； Phosphorescent host material； Capping layer material； Top light-emitting diods