DOCTORAL THESIS

Transport and luminance of organic electronic materials

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Date of Award:
2004

Transport and Luminance of Organic Electronic Materials

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A thesis submitted in partial fulfillment of the requirements
for the degree of
Doctor of Philosophy

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Hong Kong Baptist University

November 2004

Abstract

Organic electronic materials are being widely used in many opto-electronic applications, including organic light-emitting diodes (OLEDs), photovoltaic cells, and thin film transistors. In order to explore the underlying device physics, the electrical conduction of amorphous organic materials is essential.

In this thesis, the charge transport properties of amorphous organic materials, commonly used in organic light-emitting devices are investigated by the means of carrier mobility measurements. Both hole and electron mobilities of the hole dominant materials - *N*, *N'*-diphenyl-*N*, *N'–bis*(3-methylphenyl)-(1,1'-biphenyl)-4,4'-diamine (TPD), and the electron dominant materials - *tris*(8-hydroxyquinoline) aluminum (Alq_3) are examined using time-of-flight technique inside a vacuum cryostat, regulated from 200-400 K. The effects of ambient gases on electron transport are further investigated. As doping is essential for enhancing the performance of OLEDs, its influences on the carrier mobility in organic transporters are explored. Moreover, the steric hindrance and concentration effects on the carrier transport are also studied. Carrier transport models, in combination with quantum mechanical calculations, are employed to elaborate the physics of carrier transport in both pristine and doped organic systems. Armed with understanding generated from mobilities measurement, we successfully fabricated blue-emitting OLEDs using electron transporting *tris*(2-methyl-8-hydroxyquinoline) aluminum and hole transporting naphthyl phenylamine derivatives as the light-emitting materials.

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