Concentration Quenching Mechanism in Doped OLED Materials

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Abstract

Concentration quenching of luminescence is a recognized phenomenon in practically all doped luminescent systems such as phosphors and organic LED (OLED). In small molecular OLED, doped emission layers are extensively used to improve the luminescence efficiency and the operation stability. The fluorescent dyes used as dopant materials commonly suffer an effect of concentration quenching at high doping ratio which lead to extensive reduce of the emission intensity and efficiency of the devices. Although the quenching mechanism for individual host-dopant system has been investigated, there is a lack of coherent for a general understanding on the behavior of dopant in a doped emission layer of OLED. Such understanding would allow us to appreciate for example the variation in dopant concentration that cause luminescence quenching in a host-dopant system for different dopant. If a general description can be found, then, we can predict the optimum dopant concentration for any doped organic thin films. This would allow better design of OLED device structure and greater understanding of energy transfer mechanism in OLED. Our work focus on several kind of small molecular doped system to have the concentration quenching mechanism revealed. Doping systems with different concentration and different materials are fabricated. Luminescence intensity and photoluminescence lifetime of the samples were measurement. The results were fitted with similar form. Using time-resolved technique, we have investigated the energy transfer characteristics of these doped films. A correlation of dopant molecular structure with the quenching concentration was obtained, and an attempt is made to draw a general conclusion from the results. Empirical equations are then established to bring up reasonable description of quenching mechanisms.
# Contents

Declaration i  
Abstract ii  
Acknowledgement iii  
Table of Contents iv  
List of Tables vi  
List of Figures vi  
Chapter 1 Introduction 1  
Chapter 2 Theory 4  
  2.1 Basic Theory of OLED 4  
  2.2 Energy Transfer 7  
  2.3 Concentration Quenching 11  
  2.4 Electronic Transition 15  
  2.5 Photoluminescence Intensity and Lifetime 17  
  2.6 Current-Voltage Power Law Dependence 22  
Chapter 3 Experiment 24  
  3.1 Introduction 24  
  3.2 OLED Materials 24  
  3.3 Sample Fabrication 27  
  3.4 Sample Measurement 30  
Chapter 4 Result and Discussion 35  
  4.1 Luminescence Characteristics of BUBD1 35  
  4.2 MADN: BUBD1 37  
  4.3 MADN:Rubrene 54  
  4.4 Alq3:RD3 58  
  4.5 ααADN:BUBD1 62  
Chapter 5 Summary and Analysis 70  
  5.1 Estimation of Lifetime 70