

MASTER'S THESIS

Energy transfer in hybrid system consisting of quantum dots/quantum wells and small luminescent molecules

Wu, Weiwei

Date of Award:
2009

[Link to publication](#)

General rights

Copyright and intellectual property rights for the publications made accessible in HKBU Scholars are retained by the authors and/or other copyright owners. In addition to the restrictions prescribed by the Copyright Ordinance of Hong Kong, all users and readers must also observe the following terms of use:

- Users may download and print one copy of any publication from HKBU Scholars for the purpose of private study or research
- Users cannot further distribute the material or use it for any profit-making activity or commercial gain
- To share publications in HKBU Scholars with others, users are welcome to freely distribute the permanent URL assigned to the publication

**Energy Transfer in Hybrid System Consisting
of Quantum Dots/ Quantum Wells and Small
Luminescent Molecules**

WU Weiwei

A thesis submitted in partial fulfillment of the requirements

for the degree of

Master of Philosophy

Principal Supervisor: Prof. K. W. Cheah

Hong Kong Baptist University

September 2009

Abstract

The hybrid system consisting of low-dimensional semiconductors and organics is interesting both in fundamental and applied physics. The energy transfer is of great importance in the system. We have studied two kinds of hybrid system: one is CdSe/ZnS Quantum Dots (QDs) hybridizing with N-(4-methoxyphenyl)-N-phenyl-naphthalen-1-amine (MeONPA), the other is GaN-based Quantum Wells (QWs) with (4'-methoxy)-9-phenylcarbazole (MeOKPA). In these systems, the distance between the transition dipoles of inorganic and organic components is in the effect range of Förster Resonance Energy Transfer. By measuring Photoluminescence (PL), PL Excitation (PLE), Decay Lifetime, Two-Photon-Induced Fluorescence (TPIF), Power-Dependent PL and Temperature-Dependent PL spectra of the hybrid systems, we have observed the phenomenon of energy transfer. The MeONPA/QDs system shows efficient energy transfer under two-photon excitation, but the luminescence of QDs is quenched under one-photon excitation. This property can be utilized in application of bio-detector. The QWs/MeOKPA system shows efficient energy transfer. This property can be utilized in a variety of light emitting devices.

Table of Contents

Declaration	i
Abstract.....	ii
Acknowledgements	iii
Table of Contents	iv
List of Figures.....	vii
Chapter 1. Introduction	1
1.1 Motivation.....	1
1.2 Outline.....	3
Chapter 2. Theory	5
2.1 Development of Resonance Energy Transfer Theory.....	5
2.2 Review of Förster's Theory	6
2.3 Strong Coupling in Hybrid System of QWs and Organic Layers	10
2.4 Low-Dimensional Structures	12

Chapter 3. Experiment.....	16
3.1 Sample Preparation.....	16
3.1.1 QDs.....	16
3.1.2 QWs.....	18
3.1.3 Organics.....	18
3.1.4 Spin Coating.....	19
3.1.5 Thermal Evaporation.....	22
3.2 Optical Experiment.....	24
3.2.1 Photoluminescence (PL).....	26
3.2.2 PL Excitation (PLE).....	27
3.2.3 Decay Lifetime.....	28
3.2.4 Two-Photon-Induced Fluorescence (TPF).....	28
3.2.5 Power-Dependent PL.....	29
3.2.6 Temperature-Dependent PL.....	29
Chapter 4. Results and Discussion.....	30
4.1 Results of MeONPA/QDs Hybrid System.....	30
4.1.1 One-Photon Excitation.....	30
4.1.2 Two-Photon-Induced Fluorescence.....	38
4.2 Discussion of MeONPA/QDs Hybrid System.....	39

4.3	Results of QWs/MeOKPA Hybrid System	44
4.4	Discussion of QWs/MeOKPA Hybrid System.....	49
Chapter 5.	Conclusion and Future Works	54
	References.....	56
	Curriculum Vitae	59
	Conference Presentations and Publications	60