

Contents

Abstract	I
Acknowledgments.....	III
Contents.....	IV
List of Figures.....	VI
Chapter 1 Introduction	
1.1 Introduction of the nanotechnology.....	1
1.2 Properties of the ZnO	3
1.3 The Review of the ZnO nanostructures.....	3
1.4 Motivation.....	4
1.5 Organization of the thesis.....	5
Chapter 2 Theoretical background.....	
6	
2.1 The mechanism of ZnO nanowires formation.....	6
2.2 X-ray diffraction.....	8
2.2.1 ω - 2θ scan.....	8
2.2.2 Rocking Curve.....	10
2.3 PL Characterization.....	10
2.3.1 Fundamental Transition.....	11
2.3.2 Influence of high excited light intensity.....	13
2.4 Raman scattering.....	16
2.5 SEM.....	17
2.6 Transmission electron microscopy (TEM).....	19

Chapter 3 Experiment Process Detail.....23

3.1 Sample Preparation23

 3.1.1 Surface treatment of the substrate.....23

 3.1.2 NiO thin film preparation.....23

 3.1.3 ZnO nanowires growth.....23

3.2 X-ray diffraction.....25

3.3 SEM system.....25

3.4 TEM.....25

3.5 PL system.....25

Chapter 4 Results and Discussion.....28

4.1 Growth of the ZnO nanowires.....28

 4.1.1 The growth mechanism of the ZnO nanowires.....28

 4.1.2 The influence of ambient pressure.....31

 4.1.3 The diameters of the ZnO nanowires.....32

4.1 Result of TEM.....35

4.2 Result of the X-ray diffraction measurement.....36

4.3 Result of the Raman scattering.....36

4.4 PL spectra of ZnO nanowires.....39

 4.5.1 Room-Temperature.....39

 4.5.2 Temperature and Power dependent PL.....41

 4.5.3 High exciting power density.....44

Chapter 5 Conclusion and future work.....45

5.1 Conclusion.....45

5.2 Future work.....46

Reference.....47

List of Figures

Fig. 1-1. Diagram of top-down and bottom-up.....1

Fig. 1-2. The development tendency of minimum process.....2

Fig. 1-3. The nano-logic gate and nano-laser source are made of assembled Si nanowires and the makes of the ZnO nanowires.3

Fig. 1-4. The nano-spring ,inverse structure ,and the periodic ZnO nanowires4

Fig. 2-1. VLS method.....7

Fig. 2-2. Au-Zn phase diagram.....7

Fig. 2-3. Two sets of Bragg planes in an NaCl crystal and X-ray scattering from a cubic crystal.....8

Fig. 2-4. The hexagonal unit cell.....10

Fig. 2-5. Radiative transition between a band and an impurity state.....13

Fig. 2-6. The general scenario for many-particle effects in semiconductors.....14

Fig. 2-7. Schematic representation of the inelastic exciton-exciton scattering processes.....15

Fig. 2-8. Closed circuit TV and scanning electron microscope.....19

Fig. 2-9 Schematic showing electrons and electromagnetic waves emitted from a specimen as a result of elastic and inelastic scattering of the incident electron waves.....20

Fig. 2-10 Schematic ray diagram for a three-lens imaging microscope operated for imaging selected area diffraction.....22

Fig. 3-1. Chemical vapor transport and condensation system.....24

Fig. 3-2. PL system.....27

Fig. 3-3. High power pumping PL system.....27

Fig. 4-1. The ZnO attracted by the NiO pattern28

Fig. 4-2. The ZnO nanowires grown on the substrate with and without NiO, and under the process: 50torr, 550°C, 50sccm Ar flow for 30mins29

Fig. 4-3. The cross-section SEM image of the ZnO nanowires grown in the condition: 50torr, 600°C, 50sccm Ar flow for 30mins.....29

Fig. 4-4. The ZnO nanowires grown on the high quality ZnO thin film.....30

Fig. 4-5. The mechanism of growing ZnO nanowires.....30

Fig. 4-6. The sketch of turbulent gas flow condition, and laminar flow condition.....31

Fig. 4-7. The SEM of the ZnO nanowires grown at various grown pressures.....33

Fig. 4-8. The diagram of the diameters vs. ambient pressure.....34

Fig. 4-9. TEM image of a nanowire. The insert of Fig.4-13 is the SAD pattern.....35

Fig. 4-10. The $\theta/2\theta$ XRD pattern and rocking curve of the ZnO nanowires grown at 50torr, 600°C, 50sccm, 30mins.....37

Fig. 4-11. The Raman spectrum of the ZnO nanowires grown at 50torr, 600°C, 50sccm, 30mins.....38

Fig. 4-12. The room temperature photoluminescence spectra and variation of the full-width half-maximum peak position of the ZnO nanowires grown from 50~150torr.....40

Fig. 4-13. The temperature dependence PL of the ZnO nanowires with theoretical fitting curve.....42

Fig. 4-14. The low temperature power density dependence PL spectrum of the ZnO nanowires.....43

Fig 4-15. The room temperature spectrum of the ZnO nanowires at high pumping power density44

