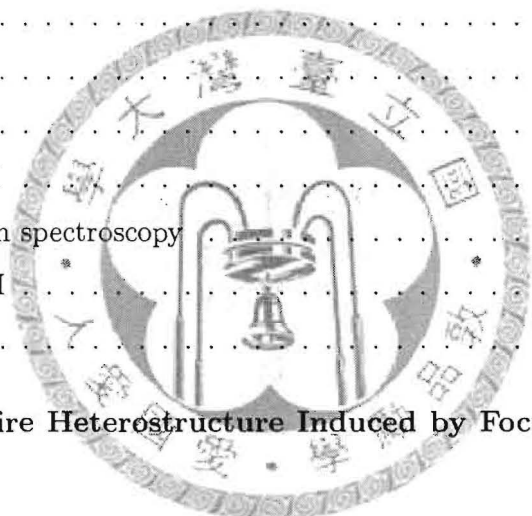


Contents

| | | |
|----------|---|-----------|
| 1 | Introduction | 1 |
| 2 | Basic Concepts | 7 |
| 2.1 | Carbon nanotubes(CNTs) | 7 |
| 2.2 | sp^1 , sp^2 , sp^3 -hybridized carbon | 9 |
| 2.3 | Proton-implanted mechanism | 10 |
| 3 | Experimental Apparatus | 12 |
| 3.1 | NSRRC | 13 |
| 3.2 | X-ray Photoelectron Spectroscopy (XPS) | 14 |
| 3.2.1 | Secondary Electron (SE) | 18 |
| 3.2.2 | Auger Electron Spectroscopy (AES) | 19 |
| 3.2.3 | XPS peak width | 21 |
| 3.2.4 | Spin-orbit coupling | 22 |
| 3.3 | Scanning PhotoElectron Microscopy (SPEM) | 23 |
| 3.3.1 | Focusing optics | 25 |
| 3.3.2 | 16-channel hemispherical electron analyzer | 30 |
| 3.3.3 | Mapping image | 32 |
| 3.4 | PhotoElectron Emission Microscopy (PEEM) | 33 |
| 3.5 | Near-Edge X-ray Absorption Fine Structure (NEXAFS) | 35 |
| 4 | Enhanced Chemical Shift of Carbon Nanotube from Laser Assisted Gas Incorporation | 42 |
| 4.1 | Introduction | 42 |
| 4.2 | Fabrication | 43 |

| | | |
|----------|---|------------|
| 4.3 | Focused laser technology | 43 |
| 4.4 | Results | 45 |
| 4.4.1 | SEM | 45 |
| 4.4.2 | Air-treated CNTs | 49 |
| 4.4.3 | Nitrogen-treated CNTs | 54 |
| 4.4.4 | Oxygen-treated CNTs | 58 |
| 4.5 | Discussion | 60 |
| 5 | Localized Electronic Manipulation of Graphene by Proton-irradiation | 62 |
| 5.1 | Introduction | 62 |
| 5.2 | Fabrication of graphene/SiC | 63 |
| 5.3 | Proton irradiation | 65 |
| 5.4 | Results | 67 |
| 5.4.1 | SEM | 67 |
| 5.4.2 | AFM | 67 |
| 5.4.3 | SPEM | 72 |
| 5.4.4 | Raman spectroscopy | 90 |
| 5.4.5 | PEEM | 94 |
| 5.5 | Discussion | 101 |
| 6 | Cu-CuO Nanowire Heterostructure Induced by Focused Laser Irradiation | 103 |
| 6.1 | Introduction | 103 |
| 6.2 | Fabrication | 105 |
| 6.3 | Results | 105 |
| 6.3.1 | SPEM | 106 |
| 6.3.2 | EDS-TEM | 111 |
| 6.3.3 | BSE | 113 |
| 6.4 | Discussion | 114 |
| 7 | Conclusion | 116 |
| | Bibliography | 120 |



| | |
|--------------------------------|-----|
| Appendix | 131 |
| A.1 Curriculum Vitae | 131 |

