# CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Statement</td>
<td>i</td>
</tr>
<tr>
<td>Certificate</td>
<td>ii</td>
</tr>
<tr>
<td>Acknowledgements</td>
<td>iii</td>
</tr>
<tr>
<td>Preface</td>
<td>vii</td>
</tr>
<tr>
<td><strong>Chapter 1. A brief Introduction on Organic and Inorganic Nanostructured Systems</strong></td>
<td></td>
</tr>
<tr>
<td>1.1. Introduction</td>
<td>1</td>
</tr>
<tr>
<td>1.2. Nanotechnology and Nanoscale Properties</td>
<td>2</td>
</tr>
<tr>
<td>1.3. Metal nanoparticles</td>
<td>5</td>
</tr>
<tr>
<td>1.3.1. Monolayer protected metal nanoparticles</td>
<td>6</td>
</tr>
<tr>
<td>1.3.2. Chromophore functionalized metal nanoparticles</td>
<td>9</td>
</tr>
<tr>
<td>1.4. Metal nanorods</td>
<td>11</td>
</tr>
<tr>
<td>1.5. Organic nanoparticles</td>
<td>14</td>
</tr>
<tr>
<td>1.5.1 Design of organic nanoparticles</td>
<td>16</td>
</tr>
<tr>
<td>1.6. References</td>
<td>20</td>
</tr>
<tr>
<td><strong>Chapter 2. Synthesis and Photophysical Studies of Fullerene Based Nanoclusters</strong></td>
<td></td>
</tr>
<tr>
<td>2.1. Abstract</td>
<td>25</td>
</tr>
<tr>
<td>2.2. Introduction</td>
<td>26</td>
</tr>
<tr>
<td>2.3. Results and discussion</td>
<td>30</td>
</tr>
<tr>
<td>2.3.1. Synthesis</td>
<td>30</td>
</tr>
<tr>
<td>2.3.2. Steady state absorption properties</td>
<td>32</td>
</tr>
<tr>
<td>Section</td>
<td>Title</td>
</tr>
<tr>
<td>---------</td>
<td>-------</td>
</tr>
<tr>
<td>2.3.3.</td>
<td>Steady state emission properties</td>
</tr>
<tr>
<td>2.3.4.</td>
<td>Characterization of the clusters</td>
</tr>
<tr>
<td>2.3.5.</td>
<td>Computational studies</td>
</tr>
<tr>
<td>2.3.6.</td>
<td>AFM studies</td>
</tr>
<tr>
<td>2.3.7.</td>
<td>Transient absorption studies</td>
</tr>
<tr>
<td>2.3.8.</td>
<td>Excited state interaction with an electron donor</td>
</tr>
<tr>
<td>2.3.9.</td>
<td>Light induced electron transfer between clusters of bis- and tris-C$_{60}$ and electron donor</td>
</tr>
</tbody>
</table>

**Chapter 3. Synthesis and Photophysical Studies of Fullerene Functionalized Gold Nanoclusters**

<table>
<thead>
<tr>
<th>Section</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.1.</td>
<td>Abstract</td>
</tr>
<tr>
<td>3.2.</td>
<td>Introduction</td>
</tr>
<tr>
<td>3.2.1</td>
<td>Optical properties of metal nanoparticles: Plasmon absorption</td>
</tr>
<tr>
<td>3.2.2</td>
<td>Electrochemical properties of monolayer protected clusters</td>
</tr>
<tr>
<td>3.2.3.</td>
<td>Photochemistry of chromophore functionalized noble metal nanoparticles</td>
</tr>
<tr>
<td>3.2.4</td>
<td>Photophysical properties of C$_{60}$</td>
</tr>
<tr>
<td>3.3.</td>
<td>Results and discussion</td>
</tr>
<tr>
<td>3.3.1.</td>
<td>Synthesis of fullerene functionalized gold nanoparticles</td>
</tr>
<tr>
<td>3.3.2.</td>
<td>Absorption studies</td>
</tr>
<tr>
<td>3.3.3.</td>
<td>Characterization of Au-S-R-C$_{60}$</td>
</tr>
</tbody>
</table>
3.3.4. Interaction of photoexcited fullerene and gold nanocore 87
3.3.5. Transient absorption studies 88
3.3.6. Photoinduced electron transfer studies 90
3.3.7. Assembling Au-S-R-C₆₀ as three-dimensional arrays 94
3.3.8. Photocurrent generation 96
3.4. Conclusions 98
3.5. Experimental Section 99
3.6. References 103

Chapter 4. Interplasmon Coupling in Gold Nanorods through Preferential End to End Assembly

4.1. Abstract 107
4.2. Introduction 108
4.2.1. Optical properties of metal nanorods 108
4.2.2. Self-assembly of nanoparticles 112
4.3. Results and discussion 116
4.3.1. Synthesis and characterization of gold nanorods 116
4.3.2. Effect of cysteine 121
4.3.3. Effect of (3-mercaptopropyl)trimethoxysilane (MPS) 129
4.3.4. Effect of dodecanethiol 134
4.3.5. Effect of ionic strength of the medium 135
4.4. Conclusions 137
4.5. References 139