

## Index

<b>1. Background</b>	
<b>1.1 Introduction.....</b>	<b>2</b>
<b>1.2 Electronic and geometric structures of different metal species.....</b>	<b>5</b>
<b>1.3 Influence of particle size on the metal-support and metal-reactant interaction.....</b>	<b>9</b>
<b>1.4 Catalytic applications of supported single atoms.....</b>	<b>22</b>
<b>1.5 Catalytic applications of metal clusters.....</b>	<b>52</b>
<b>1.6 Non-noble metal catalysts for heterogeneous catalysis.....</b>	<b>83</b>
<b>2. Objectives.....</b>	<b>126</b>
<b>3. Synthesis of Surface-Clean CuO<sub>x</sub> Nanoparticles and Their Catalytic Properties for Oxidative Coupling of Alkynes.....</b>	<b>131</b>
<b>4. Comparative Study on the Catalytic Behavior of Supported Single Pt Atoms, Clusters and Nanoparticles.....</b>	<b>176</b>
<b>5. Generation of Subnanometric Platinum with High Stability During Transformation of 2D into 3D Zeolite.....</b>	<b>201</b>
<b>6. Evolution and Stabilization of Subnanometric Metal Species in Confined Space by <i>in situ</i> TEM.....</b>	<b>240</b>
<b>7. Generation of Gold Nanoclusters Encapsulated in MCM-22 Zeolite for Aerobic Oxidation of Cyclohexane.....</b>	<b>288</b>
<b>8. Non-noble Metal Catalysts for Hydrogenation: a Facile Method for Preparing Co Nanoparticles Covered by Thin Layered Carbon...310</b>	

<b>9. Transforming Mono and Bimetallic Non-Noble Metal Nanoparticles into Active and Chemoselective Hydrogenation Catalysts.....</b>	<b>342</b>
<b>10. Directing the Chemoselective Hydrogenation of Nitroarenes into the Corresponding Nitroso, Aromatic Azoxy and Azo Compounds with Non-Noble Metal Catalysts.....</b>	<b>383</b>
<b>11. Sunlight-assisted Hydrogenation of CO<sub>2</sub> into ethanol and C<sub>2</sub>+ Hydrocarbons by Sodium-promoted Co@C Nanocomposites.....</b>	<b>438</b>
<b>12. Perspectives.....</b>	<b>484</b>
<b>13. Abstract of the thesis.....</b>	<b>489</b>
<b>14. Curriculum Vitae.....</b>	<b>493</b>