Contents

		Page
Abstract		vii
Acknowledgments		
Contents		xi
List of Figu	res	xiii
List of Tables		
List of Sym	bols	xix
List of Abb	reviations	xix
Chapter 1	: Introduction	1
1.1	Purpose of the study	1
1.2	Objectives and scope	2
1.3	Brief results and future perspective of the work	2
Chapter 2	: Literature review	7
2.1	Photocatalytic degradation of industrial dyes	7
2.2	Catalytic Soot Oxidation	7
2.3	Carbon nanomaterials for energy and environmental based applications	8
2.4	All Inorganic halide CsPbX $_3$ perovskites – increase stability by protecting with metal	9
	oxides and making composite with graphitic carbon nitride (GCN)	
•	: HfO2/TiO2 spherical nanoparticles for visible photocatalytic water remediation of	11
industrial	dyes.	
3.1	Experimental Section	11
	3.1.1 Synthesis of HfO2/TiO2 spherical nanoparticles	11
	3.1.2 Photocatalytic degradation using HfO2/TiO2 spherical nanoparticles	11
3.2	Results and Discussion	12
	3.2.1 Structural and Morphological characterization	12
	3.2.2 Photocatalytic activity	13
3.3	Conclusion	17
Chapter 4	4: Solution Processed Hafnia Nanoaggregates: Influence of Surface Oxygen on	19
Catalytic S	Soot Oxidation	
4.1	Experimental Section	19
	4.1.1 Synthesis of HfO2 Nanoparticles	19
	4.1.2 Soot Oxidation Activity	20
4.2	Results and Discussion	20
	4.2.1 Structural Analysis	20
	4.2.2 Textural Analysis: TEM Analysis	21
	4.2.3 Textural Analysis: BET Analysis	22
	4.2.4 Chemical Analysis: XPS Analysis	23
	4.2.5 O_2 Temperature-Programmed Desorption (O_2 -TPD)	25
	4.2.6 Activity Test: Soot Oxidation Activity	26
4.3	Conclusion	28
Chapter y	5: Natural Clay Transfiguration using Ni/Co Nanoparticle as Green Catalyst for	29
-	ow-Temperature Catalytic Soot Oxidation	-
5.1	Experimental Techniques	29
-	5.1.1 Methods	29
5.2	Results and Discussion	29
	5.2.1 Clay soot oxidation	29
5.3	Conclusion	34
		21
-	: Nitrogen Enriched Carbon Nanobubbles and Carbon Spheres: A Study Involving	35
	Energy Harvesting, Storage and CO₂ Adsorption Applications	
6.1	Experimental Techniques	35

xi

	6.1.1 Preparation of Carbon Spheres (CS)	35
	6.1.2 Preparation of Carbon Nanobubbles (CNB)	35
	6.1.3 Electrode and Device Fabrication	35
6.2	Results and Discussion	36
	6.2.1 Reaction Details	36
	6.2.2 Morphological, Textural and Structural Analysis	37
	6.2.3 Chemical Analysis	39
	6.2.4 Application for CO $_2$ Capture	40
	6.2.5 Application as photoanode for DSSC	41
	6.2.6 Application as counter electrode for DSSC	43
	6.2.7 Application as material for supercapacitor	44
6.3	Conclusion	46
	esium Lead Halide Perovskite (CsPbX ₃) Nanocrystal Composites with Graphitic	47
	de (GCN) and Metal Oxide for Photo-electrocatalytic Applications	
	Experimental Techniques	47
	7.1.1 Preparation of Cesium oleate	47
	7.1.2 Preparation of cesium lead halide quantum dots (CsPbBr ₃)	47
-	Results and Discussion	48
7.3	Conclusion	54
Chapter 8: C		55
	Summary	55
8.2	Future scope	55
Publications		57
Annexure A:	Materials and methods	59
A.1	Reagents	59
A.2	Solar cell fabrication	59
	A.2.1 Photoanode Preparation for DSSC	59
	A.2.2 Counter electrode preparation for DSSC	60
	A.2.3 DSSC device fabrication	60
A.3	Instrumentation Techniques	60
A.4	Software used	60
References		61