

TABLE OF CONTENTS

Sr. No.	Title	Page No.
-	Abstract	I-III
-	List of abbreviations/symbols	IV-VII
-	List of Figures/Schemes/Tables	VIII-XV
Chapter 1: Introduction		1-32
1.1	Introduction	2
1.1.1	Nanocomposites	3
1.2	The carbon family	4
1.3	Graphene	5
1.4	Configuration and chemistry of graphene	7
1.5	Properties of graphene	8
1.6	Synthesis of graphene oxide (GO) and reduced graphene oxide (rGO)	9
1.7	Graphene based nanocomposites	10
1.7.1	Graphene-inorganic nanocomposites	10
1.7.2	Graphene-polymer nanocomposites	12
1.8	Functionalization of graphene oxide-based nanocomposites	12
1.8.1	Functionalization of graphene oxide-based nanocomposite with surfactants	14
1.8.2	Functionalization of graphene oxide-based nanocomposite with DESs	17
1.8.3	Functionalization of graphene oxide-based nanocomposite with polymers	18
1.9	Applications of GO based NCs	19
1.10	Aim and objectives of work	21
1.11	Constitution of the thesis	23
1.12	References	24
Chapter 2: Materials, methods and characterization techniques		33-55
2.1	Introduction	34
2.2	Materials	34
2.3	Methods	36
2.3.1	Synthesis of graphene oxide	36

2.3.2	Synthesis of GO@ZrO ₂ nanocomposite	37
2.3.3	Synthesis of GO@TiO ₂ nanocomposite	38
2.3.4	Synthesis of GO@ZnO nanocomposite	38
2.3.5	Functionalization of nanocomposites with surfactants	39
2.3.6	Preparation of DESs	39
2.3.7	Functionalization of nanocomposites with DES	39
2.3.8	Fabrication of mixed matrix membranes from PC/PS blend and nanofillers	40
2.3.9	Dye adsorption study	41
2.3.10	Determination of pH at the point of zero charge (pH _{pzc})	42
2.3.11	Dye re-adsorption study	42
2.3.12	Gas permeability measurements	42
2.3.13	Porosity by dry-wet weight technique	43
2.4	Characterization techniques	44
2.4.1	Fourier transform infrared spectroscopy (FTIR)	44
2.4.2	X-ray diffraction (XRD)	45
2.4.3	Thermogravimetric analysis (TGA)	46
2.4.4	Field emission scanning electron microscopy (FESEM) and energy-dispersive X-ray spectroscopy (EDX)	47
2.4.5	Transmission electron microscopy (TEM)	48
2.4.6	Ultraviolet-visible spectroscopy (UV-vis)	49
2.4.7	Tensile properties	50
2.4.8	Differential Scanning Calorimetry (DSC)	51
2.4.9	Contact angle measurement	52
2.5	References	54
Chapter 3: Synthesis and characterization of surfactant/DES modified GO@ZrO₂ NC for adsorption of dye from aqueous background		56-81
3.1	Introduction	57
3.2	Experimental section	59
3.3	Result and discussion	59
3.3.1	XRD	59
3.3.2	FTIR	59
3.3.3	TEM	60
3.3.4	SEM-EDX	60
3.3.5	TGA	62

3.3.6	Influence of [MB]	62
3.3.7	Influence of Composite Load	63
3.3.8	Influence of pH	64
3.3.9	Influence of Contact Time: Adsorption Kinetics	66
3.3.10	Adsorption isotherm	69
3.3.11	Comparison of MB adsorption with similar composite material	73
3.3.12	Recyclability/Reusability Study	73
3.3.13	Mechanism of MB adsorption	75
3.4	Conclusion	76
3.5	References	77
Chapter 4: Synthesis and characterization of surfactant/DES modified GO@TiO₂ NC for adsorption of dye from aqueous background		82-108
4.1	Introduction	83
4.2	Experimental section	85
4.3	Results and Discussion	85
4.3.1	XRD	85
4.3.2	FTIR	86
4.3.3	FESEM-EDX	87
4.3.4	TGA	89
4.3.5	Effect of [MB]	89
4.3.6	Effect of Composite Load	90
4.3.7	Effect of pH	91
4.3.8	Effect of Contact Time: Adsorption Kinetics	93
4.3.9	Adsorption isotherm	96
4.3.10	Investigation of MB adsorption with comparable composite material	99
4.3.11	Recyclability and reusability Study	100
4.3.12	MB adsorption mechanism	102
4.4	Conclusion	103
4.5	References	105

Chapter 5: GO/surfactant inspired photophysical modulation of dye in DESs with or without additives	109-127
5.1 Introduction	110
5.2 Experimental section	112
5.3 Results and Discussion	112
5.3.1 RB absorption spectra in Reline	112
5.3.2 Fluorescence spectra of RB	113
5.4 Conclusion	122
5.5 References	123
Chapter 6: A polymer blend NCs for the separation and purification of gases	128-159
6.1 Introduction	129
6.2 Experimental section	132
6.3 Result and discussion	132
6.3.1 FTIR	132
6.3.2 XRD	134
6.3.3 SEM-EDX	135
6.3.4 Thermal Properties	138
6.3.5 Contact Angle Analysis	141
6.3.6 Thickness and Porosity Measurements	142
6.3.7 Mechanical Properties	144
6.3.8 Gas permeability	146
6.3.9 Selectivity and upper bound visualization	149
6.4 Conclusion	153
6.5 References	154
Chapter 7: Conclusion and Future Perspective	160-164
7.1 Conclusions	161
7.2 Future Perspective	163
- List of publications & list of conference/symposia/seminars/workshops/webinars	165-173
- Published research articles	174-182
- Certificates of conference/ symposia/ seminar/ workshop/webinar	183-199
- Achievements	200-203