

## TABLE OF CONTENTS

Abstract	I
Resum	III
Resumen	V
Sammanfattning	VII
Table of contents	IX
<b>Chapter 1. Motivation, aim and overview</b>	<b>1</b>
1.1. Motivation and aim	3
1.2. Overview	7
1.3. References of Chapter 1	9
1.4. Contributions of Chapter 1	11
<i>Contribution 1.1. Long-term properties and end-of-life of polymers from renewable resources</i>	13
<b>Chapter 2. Experimental methodologies for the development, characterisation and validation</b>	<b>73</b>
2.1. Experimental strategy	75
2.2. Materials and reagents	76
2.2.1. Polymers	76
2.2.2. Reagents and solvents	77
2.2.3. Obtaining of silicon microparticles	77
2.2.4. Sulfonation of poly(vinyl alcohol) (PVA)	78
2.2.5. Obtaining of graphene oxide (GO)	78
2.2.6. Sulfonation of graphene oxide (GO)	79
2.3. Processing techniques	81
2.3.1. Photo-stabilised polyolefins for outdoor applications	81
2.3.2. Polyelectrolyte membranes for fuel cells	82
2.3.3. Scaffolds for tissue engineering	88
2.4. Analytical techniques and calculation methods	90
2.4.1. Chemical structure. Fourier transform infrared spectroscopy (FT-IR)	90
2.4.2. Molar mass. Size exclusion chromatography (SEC)	91

2.4.3.	Surface morphology. Field emission scanning electron microscopy (FE-SEM)	92
2.4.4.	Thermal properties. Differential scanning calorimetry (DSC)	93
2.4.5.	Thermal and thermo-oxidative stability. Thermogravimetric analysis (TGA)	95
2.4.6.	Thermo-mechanical properties. Dynamic-mechanic-thermal analysis (DMTA)	96
2.4.7.	Dielectric properties. Dielectric-thermal impedance spectrometry (DETA)	97
2.5.	Validation of photo-stabilised polyolefins for outdoor applications	100
2.5.1.	Accelerated sunlight irradiation procedure	100
2.6.	Validation of polyelectrolyte membranes for fuel cells	102
2.6.1.	Ethanol permeability	102
2.6.2.	Swelling and solution uptake	102
2.6.3.	Behaviour under simulated service conditions	103
2.6.4.	Direct ethanol fuel cell (DEFC) test	104
2.7.	Validation of scaffolds for tissue engineering	105
2.7.1.	Hydrophilicity. Contact angle	105
2.7.2.	Biocompatibility	106
2.7.3.	<i>In vitro</i> hydrolytic degradation in physiologic conditions	110
2.8.	References of Chapter 2	113

<b>Chapter 3.</b>	<b>Photo-stabilised polyolefins for outdoor applications</b>	<b>117</b>
3.1.	Polyolefin degradation: polypropylene (PP) as a model case	119
3.2.	Ultraviolet stabilisation of polypropylene (PP)	123
3.2.1.	Radical scavengers	123
3.2.2.	Hydroperoxide decomposers	124
3.2.3.	Deactivators/energy quenchers	125
3.2.4.	UV light absorbers	125
3.2.5.	UV light screeners	126
3.3.	Silicon microparticles as novel ultraviolet stabilisers	127
3.4.	References of Chapter 3	129

3.5.	Contributions of Chapter 3	133
<i>Contribution 3.1. Novel silicon microparticles to improve sunlight stability of raw polypropylene</i>		135
<b>Chapter 4.</b>	<b>Polyelectrolyte membranes for fuel cells</b>	<b>163</b>
4.1.	Proton exchange fuel cells fed with alcohols	165
4.2.	Poly(vinyl alcohol) (PVA)-based polyelectrolyte membranes	170
4.2.1.	Nanocomposite PVA-based polyelectrolytes	172
4.2.2.	Blended PVA-CS polyelectrolytes	177
4.3.	References of Chapter 4	179
4.4.	Contributions of Chapter 4	187
<i>Contribution 4.1. Functionalised poly(vinyl alcohol)/ graphene oxide membranes for energy applications</i>		189
<i>Contribution 4.2. Crosslinked sulfonated poly(vinyl alcohol)/ graphene oxide electrospun nanofibres as polyelectrolytes</i>		205
<i>Contribution 4.3. Crosslinked chitosan/poly(vinyl alcohol)-based membranes for proton exchange polyelectrolytes</i>		237
<b>Chapter 5.</b>	<b>Scaffolds for tissue engineering</b>	<b>263</b>
5.1.	Tissue engineering	265
5.2.	Polymer-based functionalised scaffolds	269
5.2.1.	Poly(lactide-co-glycolide) (PLGA)	273
5.2.2.	Polycaprolactone (PCL)	273
5.2.3.	Polyhydroxybutyrate (PHB)	274
5.2.4.	Polydioxanone (PDO)	274
5.2.5.	Gelatin (Ge)	275
5.3.	References of Chapter 5	277
5.4.	Contributions of Chapter 5	283
<i>Contribution 5.1. In vitro validation of biomedical polyester-based scaffolds: poly(lactide-co-glycolide) as model-case</i>		287
<i>Contribution 5.2. Comparison of in vitro hydrolytic degradation patterns of short-term and long-term polyester-based electrospun scaffolds</i>		319
<i>Contribution 5.3. Effect of the dissolution time into an acid hydrolytic solvent to tailor electrospun nanofibrous polycaprolactone scaffolds</i>		351

<i>Contribution 5.4. Tailored electrospun nanofibrous polycaprolactone/gelatin scaffolds into an acid hydrolytic solvent system</i>	379
<i>Contribution 5.5. Validation of tailored electrospun nanofibrous polycaprolactone/gelatin based scaffolds</i>	403
<b>Chapter 6. Conclusions and future work</b>	<b>439</b>
<b>Glossaries</b>	<b>447</b>
Abbreviations	449
Symbols	453
<b>Other contributions</b>	<b>455</b>
Journal articles	457
Conference contributions	459
Scientific divulgation articles	463
<b>Acknowledgements</b>	<b>465</b>