

Contents

Contents	xi
List of Figures	xiv
List of Tables	xviii
Nomenclature	xxi
1 Introduction	1
1.1 Background	2
1.2 Motivation	3
1.3 Objectives	3
1.4 Contents	4
1.5 References	6
2 Literature review	9
2.1 Introduction	10
2.2 Emissions	10
2.3 Oxycombustion	31
2.4 Oxygen production methods	35
2.5 Summary	40
2.6 References	43
3 Methodology	55
3.1 Introduction	56
3.2 Software	56
3.3 Membrane model	57
3.4 Combustion modeling for spark-ignition engine	58
3.5 Turbocharging modeling and scaling	64
3.6 Subsystems modeling	65
3.7 Summary	66
3.8 References	68

4	Evaluation of an oxygen production cycle using MIEC membranes for industrial applications.	71
4.1	Introduction	73
4.2	System description	73
4.3	Considerations, variables, and indicators for performance evaluation	75
4.4	Case 1: Oxygen production without an additional heat source	78
4.5	Case 2: Oxygen production with an additional heat source	86
4.6	Cases performance comparison	94
4.7	Comparison with other oxygen production methods	97
4.8	Summary	97
4.9	References	100
5	Assessment of an oxygen production cycle and a power production cycle (Graz Cycle) coupling	101
5.1	Introduction	104
5.2	System description	104
5.3	Considerations, variables, and indicators for performance evaluation.	110
5.4	System evaluation using a three-end membrane	116
5.5	System evaluation using a four-end membrane	128
5.6	Performance comparison	135
5.7	Summary	142
5.8	References	144
6	Oxygen production using a MIEC membrane for spark-ignition engines operation.	147
6.1	Introduction	151
6.2	System description	151
6.3	Engine specifications and benchmarking	154
6.4	Considerations, variables, and indicators for performance evaluation	154
6.5	Component selection	158
6.6	Full load operation	159
6.7	Part-load	184
6.8	Altitude	203
6.9	Summary	213
6.10	References	215
7	Conclusions and future works	217
7.1	Introduction	218
7.2	Oxygen production cycle for an industrial application	219

7.3	Coupling of an oxygen production cycle and a power production cycle under oxycombustion	220
7.4	A spark-ignition engine under oxycombustion with oxygen production in situ	221
7.5	Main conclusions	223
7.6	Limitations and future works	224
	References	227