

Outline

Table of Contents

0 Preamble	7
Summary	7
Resumen.....	9
Resum.....	11
Context and objectives of the Thesis	13
1 Introduction.....	17
1.1 Sensor devices	17
1.2 Potentiometric sensors.....	19
1.2.1 Sensor mechanism: the vacant mechanism	19
1.2.2 Electrochemical reactions.....	25
1.3 Materials and State of the art.....	28
1.3.1 Electrolyte.....	28
1.3.2 Electrodes	28
1.4 Electrochemical activation of oxygen.....	31
1.5 Applications.....	32
1.5.1 Monitoring of gases	32
1.5.2 Monitoring of diesel exhaust gases	33
1.5.3 Other applications: Industrial gases monitoring.....	40
1.6 References.....	41
2 Methodology	55
2.1 Material synthesis	55
2.1.1 Co-precipitation	55
2.1.2 Sol-gel or Pechini Route.....	56
2.2 Sample preparation	56
2.2.1 Electrolyte.....	56
2.2.2 Electrode (catalytic layer) deposition	58
2.3 Structural characterization	59
2.3.1 Scanning Electron Microscopy (SEM)	59
2.3.2 Transmission Electron Microscopy (TEM)	60
2.3.3 X-Ray Diffraction.....	61

2.3.4	Raman spectroscopy.....	63
2.3.5	X-Ray photoelectron Spectroscopy	63
2.4	Electrochemical characterization. Sensor performance	64
2.4.1	Open circuit voltage measurement.....	64
2.4.2	Electrochemical Impedance Spectroscopy (EIS)	67
2.4.3	Experimental set-up and sensing.....	70
2.5	References.....	72
3	Study of working electrode materials for a selective C₂H₄ response	77
3.1	Introduction	77
3.2	Device structure and materials selection	78
3.3	Structural characterization	79
3.4	Electrochemical characterization	82
3.4.1	Potentiometric characterization.....	82
3.4.2	Electrochemical Impedance Spectroscopy	91
3.5	Device configuration: working electrode material selection.....	93
3.6	Conclusions	95
3.7	References.....	95
4	Water and poliaromatic hydrocarbons influence on sensor response. Reference Electrode improvement strategies	101
4.1	Introduction and motivation.....	101
4.2	Water and poliaromatic hydrocarbons influence on sensor response 102	
4.2.1	Electrochemical characterization	102
4.2.2	Raman spectroscopy.....	110
4.3	Reference electrode improvement strategies	111
4.3.1	Structural characterization	111
4.3.2	Electrochemical characterization	113
4.4	Conclusions	116
4.5	References.....	117
5	Optimization of Fe_{0.7}Cr_{1.3}O₃ working electrode through surface activation by several compounds nanoparticles deposition	123
5.1	Introduction	123
5.2	Selection of materials for surface activation	124
5.3	Electrochemical characterization	125

5.3.1	Potentiometric Characterization	127
5.3.1.1	First batch: Ni and Ru infiltration	127
5.3.1.2	Second batch: Ti and Al infiltration	130
5.3.1.3	Third batch: Niobium, barium and palladium infiltration.....	132
5.3.2	Electrochemical impedance spectroscopy	135
5.4	Structural characterization	143
5.5	Conclusions	146
5.6	References.....	147
6	Influence of 8YSZ electrolyte thickness on the sensor performance	
	153	
6.1	Introduction	153
6.2	Electrochemical characterization	154
6.2.1	Potentiometric characterization.....	154
6.2.2	Electrochemical Impedance Spectroscopy	159
6.3	Structural characterization	164
6.4	Conclusions	166
6.5	References.....	168
7	Alternatives to 8YSZ as electrolyte: CGO and ScSZ	173
7.1	Introduction	173
7.2	Electrochemical characterization	174
7.2.1	Bare sensor	174
7.2.1.1	Influence of temperature	175
7.2.2	Surface activation of working electrode by nickel nanoparticles .	177
7.2.3	Electrochemical Impedance Spectrometry.....	181
7.3	Structural characterization	187
7.4	Conclusions	188
7.5	References.....	190
8	Optimization of the sensor performance and mechanism of action	
	195	
8.1	Introduction	195
8.2	Mixed conductor electrode and NO₂ effect LSC/8YSZ as Working Electrode	197
8.2.1	LSC/8YSZ as working electrode.....	197
8.2.1.1	Structural characterization	197
8.2.1.2	Electrochemical characterization	198

8.2.2	NO ₂ effect on reference configuration sensor.....	203
8.3	Sensor mechanism of action and discussion.....	207
8.4	Conclusions	216
8.5	References.....	217
9	Conclusions and remarks.....	223
10	Acronyms.....	229
11	Figures list.....	233
12	Tables list.....	245
13	Scientific Contribution	247