

Contents

1 Planar Interdigital Sensors	1
1.1 Introduction	1
1.2 Chemical Sensors and Biosensors Applications	2
1.3 Quality of Materials	3
1.4 Food Quality and Environmental Monitoring	7
References	9
2 Novel Planar Interdigital Sensors	11
2.1 Introduction	11
2.2 Operating Principle	11
2.3 Analytical Model and Analysis	14
2.3.1 Calculation of Capacitance Using Circuit Analysis	14
2.4 Modelling Using Finite Element Analysis:	
COMSOL Multiphysics	16
2.4.1 Model Definition: COMSOL Implementation	17
2.5 Design and Fabrication Process	23
2.5.1 Conventional Interdigital Sensors	23
2.5.2 Novel Planar Interdigital Sensors	25
References	34
3 Experimental Investigation: Impedance Characterization	37
3.1 Introduction	37
3.2 Experimental Setup	37
3.3 Impedance Spectroscopy Method	37
3.3.1 Fundamental Theory of IS Method	38
3.3.2 Nyquist Plot and Bode Plot Data Presentations	40
3.4 Characterization of Sensors	44
3.4.1 Characterization of Sensors in Air	44
3.4.2 Characterization of Sensors with Ionic Solution, Sodium Chloride (NaCl)	51
3.4.3 Characterization of Sensors with Different pH	61

3.4.4	Experiments with Peptides Related to Domoic Acid	64
3.4.5	Initial Experiments with LPS O111:B4	69
	References	71
4	Coating and Immobilization of Sensors	73
4.1	Introduction	73
4.2	Coating of Sensors.	73
4.2.1	Electrospinning Method.	75
4.2.2	Spin-Coating Method.	75
4.2.3	Dip-Coating Method	76
4.3	Optical Microscopy Characterization	77
4.3.1	Bare Sensor	78
4.3.2	COATING A: Electrospun of Carboxylic Functional Polymer	78
4.3.3	COATING B: Spin Coated Carboxylic Functional Polymer	80
4.3.4	COATING C: Dip-Coated Silica Coating Functionalized with APTES	80
4.3.5	COATING D: Dip Coated Silica Coating with Thionine	81
4.4	Immobilization of Polymyxin B	81
4.4.1	Preparation of Borate Buffer	82
4.4.2	Preparation of Phosphate Buffer	82
4.4.3	Immobilization Process	84
	References	84
5	Experimental Investigation: Endotoxins	87
5.1	Introduction	87
5.2	Impedance Spectroscopy Analysis	87
5.3	Analysis on Endotoxin	92
5.3.1	Coated FR4 Sensors (1_5 Configuration).	92
5.3.2	Coated Silicon Sensors (1_5 Configuration).	95
5.4	Validation of Sensor Measurement Using Standard Chromogenic LAL Endotoxin Test Kit.	106
5.4.1	Description of the Assay Kit	107
5.4.2	Endotoxin Quantitative Detection Protocol.	108
5.4.3	Reagent Preparation	109
5.4.4	Test Procedure	110
5.4.5	Calculation of Endotoxin Concentration.	111
5.5	Sensitivity Measurement of Novel Sensors	112
5.6	Stability and Reproducibility of Sensing Performance	116
	References	126

6	Food Sample and Analysis	129
6.1	Introduction	129
6.2	Food Samples Preparation	129
6.3	Analysis on Food Samples	129
7	Conclusions	137
7.1	Introduction	137

Novel Sensors for Food Inspection: Modelling,
Fabrication and Experimentation

Abdul Rahman, M.S.; Mukhopadhyay, S.C.; Yu, P.L.

2014, IX, 140 p. 152 illus., 134 illus. in color., Hardcover

ISBN: 978-3-319-04273-2