

Contents

1	Introduction	1
	1.1 Introduction	1
	References	3
2	Polarography in Studies of Pharmaceuticals	7
	2.1 Principles of Polarography	7
	2.1.1 Comparison with Voltammetric Methods	22
	2.2 Variants of Polarography	25
	2.3 Record Keeping	26
	2.4 Supporting Electrolytes	27
	2.5 The Half-Wave Potentials and Limiting Currents	29
	2.6 Identification of the Type of the Limiting Current	31
	2.7 Role of pH	33
	2.8 Investigation of a New Compound	37
	2.9 Structure of Organic Compounds and Polarographic Activity	39
	2.10 Conclusion	41
	References	42
3	Electroanalytical Techniques Most Frequently Used in Drug Analysis	45
	3.1 Introduction	45
	3.2 Linear Sweep and Cyclic Voltammetry	49
	3.3 Step and Pulse Voltammetry	55
	3.3.1 Staircase Voltammetry	57
	3.3.2 Normal Pulse Voltammetry	58
	3.3.3 Differential Pulse Voltammetry	59
	3.3.4 Square Wave Voltammetry	62
	3.4 Alternating Current Voltammetry	65
	3.5 Stripping Techniques	67
	3.5.1 Anodic Stripping Voltammetry	69
	3.5.2 Cathodic Stripping Voltammetry	72
	3.5.3 Adsorptive Stripping Voltammetry	73

3.5.4	Abrasive Stripping Voltammetry	75
3.5.5	Potentiometric Stripping Analysis	76
3.6	Conclusions	77
	References	78
4	Solid Electrodes in Drug Analysis	83
4.1	Introduction	83
4.2	Why Solid Electrode Materials?	84
4.3	Properties of Solid Electrode Materials	85
4.4	Surface Cleaning Pre-treatments	87
4.5	Solid Electrode Materials	88
4.5.1	Metal Electrodes	88
4.5.2	Carbon Electrodes	92
4.5.3	Screen-Printed Electrodes	108
4.5.4	Chemically Modified Electrodes	110
4.6	Conclusion	114
	References	114
5	Screen-Printed Electrodes (SPE) for Drug Compounds	
	Determination	119
5.1	Introduction	119
5.2	SPE Properties	120
5.3	SPE Modifications	122
5.4	SPE Applications (Table 5.1)	123
5.4.1	Unmodified SPE	124
5.4.2	Modified SPE Surface	129
5.5	Screen-Printed Electrode and Ascorbic Acid Determination	136
5.6	Conclusion	138
	References	138
6	Electrochemical Biosensors for Drug Analysis	141
6.1	Introduction	144
6.2	Immobilization Techniques	145
6.3	Electrochemical-Based Biosensor	151
6.3.1	Amperometry and Voltammetry	151
6.3.2	Potentiometric Biosensors	175
6.3.3	Impedimetric Biosensors	180
	References	181
7	Electrochemical and Hyphenated Electrochemical Detectors	
	in Liquid Chromatography and Flow Injection Systems for Drug	
	Compound Analysis	187
7.1	Introduction	188
7.2	Basic Analytical Strategy for Implementing an Amperometric Detector Under Hydrodynamic Conditions	189
7.3	Basic Theoretical Aspects [1, 52]	193

7.3.1	LC-Amperometric Detection (LC-AD)	193
7.3.2	Wall-Jet	194
7.3.3	Thin-layer	195
7.3.4	“Coulometric”	195
7.4	LC-Pulsed Amperometric Detection (LC-PAD) [53, 54]	195
7.5	Hyphenated Techniques for LC and FIA	196
7.6	Conclusion	227
	References	227
8	Electroanalytical Method Validation in Pharmaceutical Analysis and Their Applications	235
8.1	Method Validation in Drug Assay Using Electroanalytical Techniques	235
8.2	Types of Method Validation	237
8.3	Electroanalytical Method Validation Characteristics and Their Calculations	242
8.3.1	Validation Characteristics	242
	References	263
9	Applications for Drug Assays	267
9.1	Introduction	272
9.2	Assay of Drugs	272
9.3	Examples of Electrochemical Application	276
9.3.1	Cyclic, Pulsed, and Stripping Voltammetric Methods Using Solid Electrodes in Pharmaceutical Analysis	276
9.3.2	Applications of Polarography in Pharmaceutical Analysis	305
9.3.3	Applications of LC-EC Detection in Pharmaceutical Analysis	314
9.3.4	Biosensors in Pharmaceutical Analysis (See also Chap. 6)	320
9.4	Conclusion	324
	References	325
	About the Authors	337
	About the Editor	345
	Index	347