

Contents

Preface IX

Foreword XIII

Symbols and Acronyms XV

1 Introduction – An Overview of Practical Electrochemistry 1

- Practical Hints 3
- Electrodes 3
- Measuring Instruments 7
- Electrochemical Cells 8
- Data Recording 10

2 Electrochemistry in Equilibrium 11

- Experiment 2.1: The Electrochemical Series 11
- Experiment 2.2: Standard Electrode Potentials and the Mean Activity Coefficient 15
- Experiment 2.3: pH-Measurements and Potentiometrically Indicated Titrations 21
- Experiment 2.4: Redox Titrations (Cerimetry) 26
- Experiment 2.5: Differential Potentiometric Titration 28
- Experiment 2.6: Potentiometric Measurement of the Kinetics of the Oxidation of Oxalic Acid 32
- Experiment 2.7: Polarization and Decomposition Voltage 36

3 Electrochemistry with Flowing Current 43

- Experiment 3.1: Ion Movement in an Electric Field 44
- Experiment 3.2: Paper Electrophoresis 46
- Experiment 3.3: Charge Transport in Electrolyte Solution 47
- Experiment 3.4: Conductance Titration 52
- Experiment 3.5: Chemical Constitution and Electrolytic Conductance 54

Experiment 3.6: Faraday's Law	56
Experiment 3.7: Kinetics of Ester Saponification	59
Experiment 3.8: Movement of Ions and Hittorf Transport Number	63
Experiment 3.9: Polarographic Investigation of the Electroreduction of Formaldehyde	69
Experiment 3.10: Galvanostatic Measurement of Stationary Current-Potential Curves	74
Experiment 3.11: Cyclic Voltammetry	77
Experiment 3.12: Slow Scan Cyclic Voltammetry	85
Experiment 3.13: Kinetic Investigations with Cyclic Voltammetry	88
Experiment 3.14: Numerical Simulation of Cyclic Voltammograms	93
Experiment 3.15: Cyclic Voltammetry with Microelectrodes	95
Experiment 3.16: Cyclic Voltammetry of Organic Molecules	99
Experiment 3.17: Cyclic Voltammetry in Nonaqueous Solutions	105
Experiment 3.18: Cyclic Voltammetry with Sequential Electrode Processes	107
Experiment 3.19: Cyclic Voltammetry of Aromatic Hydrocarbons	110
Experiment 3.20: Cyclic Voltammetry of Aniline and Polyaniline	113
Experiment 3.21: Galvanostatic Step Measurements	118
Experiment 3.22: Chronoamperometry	122
Experiment 3.23: Chronocoulometry	124
Experiment 3.24: Rotating Disc Electrode	126
Experiment 3.25: Rotating Ring-Disc Electrode	131
Experiment 3.26: Measurement of Electrode Impedances	134
Experiment 3.27: Corrosion Cells	137
Experiment 3.28: Aeration Cell	139
Experiment 3.29: Concentration Cell	141
Experiment 3.30: Salt Water Drop Experiment According to Evans	142
Experiment 3.31: Passivation and Activation of an Iron Surface	143
Experiment 3.32: Cyclic Voltammetry with Corroding Electrodes	145
Experiment 3.33: Oscillating Reactions	147
 4 Analytical Electrochemistry	151
Experiment 4.1: Ion-sensitive Electrode	152
Experiment 4.2: Potentiometrically Indicated Titrations	154
Experiment 4.3: Bipotentiometrically Indicated Titration	159
Experiment 4.4: Conductometrically Indicated Titration	161
Experiment 4.5: Electrogravimetry	163
Experiment 4.6: Coulometric Titration	166
Experiment 4.7: Amperometry	168
Experiment 4.8: Polarography (Fundamentals)	174
Experiment 4.9: Polarography (Advanced Methods)	178
Experiment 4.10: Anodic Stripping Voltammetry	180
Experiment 4.11: Abrasive Stripping Voltammetry	183

Experiment 4.12: Polarographic Analysis of Anions	185
Experiment 4.13: Tensammetry	188
5 Non-Traditional Electrochemistry	195
Experiment 5.1: UV-Vis Spectroscopy	195
Experiment 5.2: Surface Enhanced Raman Spectroscopy	199
Experiment 5.3: Infrared Spectroelectrochemistry	201
Experiment 5.4: Electrochromism	203
6 Electrochemical Energy Conversion and Storage	205
Experiment 6.1: Lead Acid Accumulator	205
Experiment 6.2: Discharge Behavior of Nickel-Cadmium Accumulators	210
Experiment 6.3: Performance Data of a Fuel Cell	213
7 Electrochemical Production	217
Experiment 7.1: Cementation Reaction	217
Experiment 7.2: Galvanic Copper Deposition	218
Experiment 7.3: Electrochemical Oxidation of Aluminum	220
Experiment 7.4: Kolbe Electrolysis of Acetic Acid	222
Experiment 7.5: Electrolysis of Acetyl Acetone	223
Experiment 7.6: Anodic Oxidation of Malonic Acid Diethylester	226
Experiment 7.7: Indirect Anodic Dimerization of Acetoacetic Ester (3-oxo-butyric acid ethyl ester)	227
Experiment 7.8: Electrochemical Bromination of Acetone	229
Experiment 7.9: Electrochemical Iodination of Ethano	231
Experiment 7.10: Electrochemical Production of Potassium Peroxodisulfate	233
Experiment 7.11: Yield of Chlor-alkali Electrolysis According to the Diaphragm Process	234
Appendix	237
Index	239