

Contents

Part I: Batteries

Florina Cuibus, Svetlozar Ivanov, Ulf Schwalbe, Marco Schilling and Andreas Bund
State-of-Charge and State-of-Health Estimation of Commercial LiFePO₄ Batteries by means of Impedance Spectroscopy — 3

- 1 Introduction — 3
- 2 Experimental Set-up — 5
- 3 Results and Discussion — 6
 - 3.1 SoC Measurements — 6
 - 3.2 SoH Measurements — 9
 - 3.3 Data Modelling — 11
- 4 Conclusions and Outlook — 16
- 5 References — 17

Delf Kober, Oliver Görke and Julia Kowal
Ageing Investigation of Lithium Ion LiFePO₄ Batteries with a Combination of EIS and Structural Analysis — 19

- 1 Introduction — 19
- 2 Experimental — 20
- 3 Results — 21
 - 3.1 Electrochemical Impedance Spectroscopy — 21
 - 3.2 Post-mortem Analysis — 23
- 4 Summary and outlook — 27
- 5 References — 27

Paul Büschel, Thomas Günther and Olfa Kanoun
Streamlining Calculation of the Distribution of Relaxation Times from Time Domain Data — 29

- 1 Introduction — 29
- 2 Novel Algorithm — 30
- 3 Experimental — 32
- 4 Conclusion and Outlook — 34
- 5 References — 34

Christian Reinke, Kristian Nikolowski, Mareike Wolter and Alexander Michaelis
Influence of the Anode Graphite Particle Size on the SEI Film Formation in
Lithium-Ion Cells — 35

- 1 Introduction — 35**
- 2 Experimental — 36**
- 3 Results — 39**
- 4 Conclusion — 41**
- 5 References — 42**

Thomas Günther and Olfa Kanoun

Frequency-Dependent Phase Correction for Impedance Measurements — 44

- 1 Introduction — 44**
- 2 Method — 45**
- 2.1 Measurement Model — 45**
- 2.2 Phase Correction — 46**
- 3 Experimental Validation — 47**
- 4 Conclusion — 48**
- 5 References — 48**

Sebastian Socher, Claudius Jehle and Ulrich Potthoff

On-line State Estimation of Automotive Batteries using In-situ Impedance
Spectroscopy — 49

- 1 Introduction — 49**
- 2 Experimental Details — 50**
- 3 Results and Discussion — 50**
- 3.1 Impedance Measurements — 50**
- 3.2 In-situ Impedance Measurements — 52**
- 4 Conclusions — 54**
- 5 References — 54**

Part II: Sensors

Christian Weber, Markus Tahedl and Olfa Kanoun

Capacitive Measurements for Characterizing Thin Layers of Aqueous
Solutions — 59

- 1 Introduction — 59**
- 2 Measurement Set-up — 60**
- 3 Data Validation — 62**
- 4 Experimental Investigations — 64**
- 5 Results — 67**
- 6 Conclusion — 70**
- 7 References — 71**

Łukasz Macioszek and Ryszard Rybski

Low-Frequency Dielectric Spectroscopy Approach to Water Content in Winter Premium Diesel Fuel Assessment — 73

- 1 Introduction — 73
- 2 Material and Methods — 74
- 2.1 Diesel Fuel Samples — 75
- 2.2 Electrodes — 75
- 2.3 Impedance Spectroscopy — 76
- 3 Results and Discussion — 76
- 4 Conclusion — 79
- 5 References — 80

Christian Weber, Markus Tahedl and Olfa Kanoun

A Novel Method for Capacitive Determination of the Overall Resistance of an Aqueous Solution — 81

- 1 Introduction — 81
- 2 Proposed Measurement Method — 82
- 3 Impedance Simulation — 83
- 4 Experimental Verification — 86
- 5 Conclusion — 88
- 6 References — 88

Part III: Material Characterization

Bernhard Roling and André Schirmeisen

Nanoscale Electrochemical Characterization of Materials by means of Electrostatic Force and Current Measurements — 91

- 1 Introduction — 91
- 2 Experimental — 94
- 3 Results and Discussion — 95
- 3.1 Time-Domain Electrostatic Force Spectroscopy (TD-EFS) — 95
- 3.2 Nanoscale Impedance Spectroscopy — 99
- 4 Conclusion — 102
- 5 References — 103

Abdulkadir Sanli, Abderrahmane Benchirouf, Christian Müller and Olfa Kanoun

AC Impedance Investigation of weg Multi-walled Carbon Nanotubes/PEDOT:PSS Nanocomposites Fabricated with Different Sonication Times — 105

- 1 Introduction — 105
- 2 Experimental — 106
- 2.1 Materials and Nanocomposite Preparation — 106
- 2.2 Measurement Set-up — 108

3	Results and Discussions — 108
3.1	Morphological Analysis — 108
3.2	Electrical Characteristics — 109
3.3	Equivalent Circuit Modelling — 110
4	Conclusions and Outlook — 114
5	References — 114

Part IV: Bioimpedance

Marco Carminati

From Counting Single Biological Cells to Recovering Photons: The Versatility of Contactless Impedance Sensing — 119

1	Introduction — 119
2	A General Equivalent Impedance Model — 120
3	Impedance Sensing in Cell Biology — 122
4	Impedance-Based Light Monitoring — 123
5	Common Design Criteria — 126
6	Conclusions — 128
7	References — 129

Hip Köiv, Ksenija Pesti and Rauno Gordon

Electric Impedance Measurement of Tissue Phantom Materials for Development of Medical Diagnostic Systems — 131

1	Introduction — 131
2	Materials and Methods — 132
2.1	Gelatine Phantom Preparation — 132
2.2	Plexiglas Enclosure with Electrodes — 133
2.3	Van der Pauw Method — 133
2.4	Measurement of Gelatine Sample Conductivity — 135
3	Results — 135
4	Conclusion — 136
5	References — 137

**Paco Bogóñez-Franco, Pascale Pham, Claudine Gehin,
Bertrand Massot, Georges Delhomme, Eric McAdams
and Régis Guillemaud**

Problems Encountered during Inappropriate Use of Commercial Bioimpedance Devices in Novel Applications — 138

1	Introduction — 138
2	Materials — 140
2.1	Commercial Impedance Analyzers — 140

2.2	Electrode–Skin Contact Impedance Measurement —	140
2.3	Tissue Impedance measurement —	141
2.4	Electrode–Skin Contact Impedance Electrical Model —	141
2.5	Tissue Electrical Model —	142
2.6	Fitting Impedance Measurements —	142
2.7	Errors —	142
2.8	Measurements on Healthy People —	143
3	Experimental Results —	143
3.1	Effect of Contact Impedance —	143
3.2	Effect of Contact Impedance Mismatch —	144
4	Discussion —	150
5	Conclusion —	151
6	References —	152