

Preface

This book addresses the practical issues of electrochemical impedance spectroscopy (EIS), which arise when the technique is employed as an online condition monitoring tool for electrochemical devices. The main focus is the proposed fast EIS technique, with a special application on proton exchange membrane (PEM) fuel cells. The applicability of the method is presented on various types of electrochemical devices, such as a Lithium-ion battery, a Li-S cell, and an industrial grade PEM fuel cell.

The first part of the book addresses the theoretical aspects of the fast EIS technique. It includes topics on stochastic excitation signals, time–frequency signal processing, and statistical analysis of the impedance measurements. Based on this, a unit-free condition indicator is designed, whose value directly reflects the state of health of the electrochemical device.

In the second part, an application of the fast EIS technique for condition monitoring is proposed. The material addresses each point in the process of designing and commissioning a condition monitoring system. Based on the derived probability density function of the impedance components, alarm thresholds are specified based on the desired probability of false alarm. Finally, the overall performance of such a condition monitoring system is evaluated on an industrial-grade PEM fuel cell system for detecting and evaluating various water management faults.

The final chapter of the book provides the necessary link for practical applications by proposing hardware components for an embedded condition monitoring system that consists of a multichannel high-resolution voltage monitor and a DC–DC converter capable of generating the required excitation signals. Special attention is given to the difficulties of accurate measurements of low voltage values superimposed on high potentials as well as energy efficiency of the DC–DC converter. The provided hardware implementation together with the detailed methodology represent a solid base for building an effectual condition monitoring system.

Unlike many other publications addressing the issues of electrochemical impedance spectroscopy that only cover the theoretical aspect, this book additionally provides practical guidelines for implementation as well as for commissioning and exploitation of the results. The presentation of the proposed fast EIS technique

significantly focuses on difficulties that arise from real-world implementations. The material offers a balanced overview of both the theoretical and practical aspects of performing EIS and online condition monitoring of electrochemical devices, thus offering new, valuable information attractive to both researchers and engineers.

Ljubljana, Slovenia
September 2016

Pavle Boškoski
Andrej Debenjak
Biljana Mileva Boshkoska

Fast Electrochemical Impedance Spectroscopy

As a Statistical Condition Monitoring Tool

Boškoski, P.; Debenjak, A.; Mileva Boshkoska, B.

2017, XIII, 83 p. 43 illus., 11 illus. in color., Softcover

ISBN: 978-3-319-53389-6