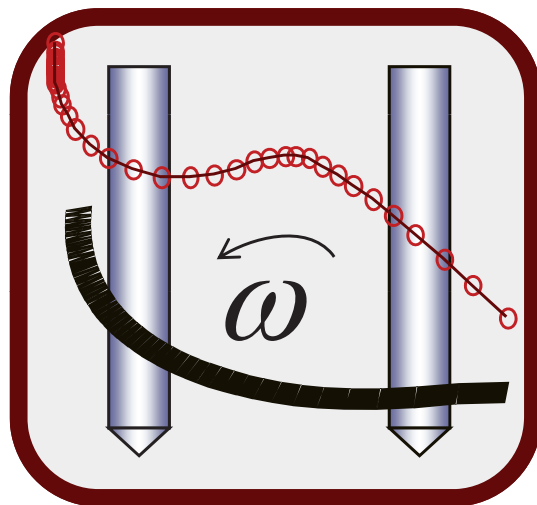


Program Book
15th International Workshop
on Impedance Spectroscopy

IWIS 2022



September 27-30, 2022
Technische Universität Chemnitz
Germany

Program Book of the International Workshop on Impedance spectroscopy 2022
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Technische Universität Chemnitz

Chairman's Welcome Message

The exchange of ideas and concepts across different scientific fields is an essential first step to finding innovative solutions for the future and the current problems of humanity. The aspired aim of the International Workshop on Impedance Spectroscopy (IWIS) is to bring together innovative and experienced scientists from different countries to discuss methods, instrumentation, and results of the recent research work in electrochemistry material science, biology and medicine, electronics and sensors. The Advanced School on Impedance Spectroscopy (ASIS), which takes place for the fourth time this year, provides a good overview of the basics around the method and makes it more accessible for young scientists. An exhibition informs about the latest news on measurement equipment and devices. These are the main components of this annual international workshop taking place at Technische Universität Chemnitz.

In its 15th edition, the IWIS includes 33 contributions from 13 countries in 7 sessions, 8 plenary talks, 3 workshops and 12 tutorials. The peer-reviewed contributions highlight new advances and present different approaches to impedance spectroscopy, including modeling, measurement and applications.

This year's IWIS is a continuation of the brilliance of the IEEE Technical Committee IM-TC 2 on Impedance Spectroscopy. In its third year, TC2 promotes Impedance Spectroscopy and standards within the IEEE community worldwide.

The workshop organization has requested a considerable effort from the organizing team of the chair for measurement and sensor technology, which makes it possible to organize this international event this year online within Technische Universität Chemnitz.

We thank the IEEE Instrumentation and Measurement Society for supporting the Advanced School on Impedance Spectroscopy and the IEEE Instrumentation and Measurement Chapter Germany for the assistance of the event. The workshop is co-organized by the Chemnitz School of Metrology (CSM e.V.), whose support for the event is highly acknowledged.

We would like to thank you for choosing IWIS 2022.

Prof. Olfa Kanoun & Prof. Abdelhamid Errachid
General Chairs

IWIS 2022 Organizers

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Contact Information

Chair for Measurement and Sensor Technology

Technische Universität Chemnitz

Reichenhainer Straße 70

09126 Chemnitz

Germany

Tel: +49 (0)371 / 531 - 24480

Fax: +49 (0)371 / 531 - 824480

Email: mst@tu-chemnitz.de

URL: <http://www.tu-chemnitz.de/iwis>

General Information

The City of Chemnitz

Chemnitz has its unique story - of ground-breaking inventions in automotive engineering, mechanical engineering or the textile industry as well as of courageous companies like Richard Hartmann, Carl Gottlieb Haubold or Louis Schönherr. As a modern industrial city, Chemnitz has continued to write its history and is today one of the fastest-growing cities in Germany. The city is a center of technology focusing on the automotive and supplier industries, information technology and mechanical and plant engineering.



Industry Museum,
(©www.chemnitz2025.de)



Rathaus, Neumarkt (©CWE - Chemnitz)

Going down their own path, experiencing new adventures and inventions - this recipe makes the city Chemnitz and its people successful: thousands of patented ideas like the thermos flask or the first mild detergent were conceived

here. Today, as an essential link in the global manufacturing chain, Chemnitz produces excellent machines and production facilities for the whole world.

A European selection jury has named the German city of Chemnitz the European Capital of Culture for 2025. The Saxonian city beat four other German cities on the shortlist: Hannover, Hildesheim, Magdeburg and Nuremberg.



Logo of Chemnitz as European capital of culture (©www.chemnitz2025.de)



Residents of Chemnitz celebrate the nomination of Chemnitz as the European Capital of Culture 2025. (©Jan Woitas/dpa)

Tradition and modernity are also reflected in exciting urban contrasts. Unique evidence like “das Bauhaus” and “die neue Sachlichkeit” or the Kaßberg, some of the largest intact areas of Wilhelminian style architecture in Europe, are deeply loved by the architecture fans. Just like Chemnitz city center, which has been redesigned over the past 20 years by internationally renowned architects such as Helmut Jahn, Hans Kollhoff and Christoph Ingenhoven.

For lovers of the fine arts there is a lot to discover in Chemnitz: For example, the Chemnitz Art Collections or the Gunzenhauser Museum, which houses one of the most impressive collections of classical modern art. Meanwhile, the Saxon



Buildings in Jugendstyle in the famous Chemnitz-Kaßberg (4.5 km² protected area as a historic monument), ([©www.chemnitz.de](http://www.chemnitz.de))

Industrial Museum traces its history and present. The Municipal Theatres with the Robert-Schumann-Philharmonie attract visitors from all over Germany.

A side-trip to the more than 100-year-old town hall is also worthwhile: the monumental Klinger-mural “Arbeit - Wohlstand - Schönheit” can be admired in the town council hall. The council hall is adorned with the work “Die Abwäng” by Neo Rauch, one of the most important contemporary artists.

Those who simply want to relax will also find a place in Chemnitz: recreation islands such as the castle pond with the adjoining kitchen forest invite you to stroll and linger as well as the historic city park along Chemnitz.

Let Chemnitz surprise you, go to discover the city by yourself - it's worth it!

Conference Venue

The International Workshop on Impedance Spectroscopy will take place in a **hybrid** form: **On-site** at TU Chemnitz and **online** using the Zoom platform.

Sponsors

The workshop is supported mainly by:

- Rutronik



- Sciospec



- rhd instruments GmbH & Co. KG



and by:

- School of Metrology CSM e.V.



- IEEE Instrumentation & Measurement Society



- IEEE IM Chapter Germany Section



- IEEE EMB Chapter Germany Section



- IEEE Technical committee IM-TC 2 on Impedance Spectroscopy



- Jauch Quartz



- Bio-Logic Science Instruments GmbH



- Safion GmbH



- ZAHNER-elektrik GmbH & Co. KG



ASIS Program

Tuesday, September 27th, 2022 : ASIS Day 1

- 09:00 - 10:15 **Tutorial 1**
Basics on Electrochemistry, Phase Boundaries and Cell Potential
Prof. Roman Gruden, Leader of Indus. Automation, Duale Hochschule Baden-Württemberg Stuttgart, Germany
- 10:15 - 10:30 **Short break**
- 10:30 - 11:45 **Tutorial 2**
Impedance Measurements - Instruments, Sensors & Beyond: An introduction on how to choose, design and successfully use setups for electrical impedance spectroscopy
Dipl. phys. Martin Bulst, Sciospec Scientific Instruments GmbH, Bennewitz, Germany
- 11:45 - 13:00 **Lunch break**
- 13:00 - 18:15 **Hands-on Workshops**
- 13:00 - 14:15 **Tutorial 3**
Electrical Relaxation Spectroscopy
Prof. Uwe Pliquet, Institut für Bioprozess- und Analysenmesstechnik e.V., Heilbad Heiligenstadt, Germany
- 14:15 - 15:30 **Tutorial 4**
Fundamentals of Electrochemical Impedance Spectroscopy
Prof. Marcio Vidotti, Professor at Universidade Federal do Paraná, Paraná, Brazil
- 15:30 - 15:45 **Short break**
- 15:45 - 17:00 **Tutorial 5**
Validation and Reconstruction of Impedance Data - Comparison Between the Meas. Model- and ZHIT Algorithm
Dr. Werner Strunz, Zahner elektrik, Kronach, Germany
- 17:00 - 18:15 **Tutorial 6**
Multisin and Dynamic Impedance Spectroscopy
Prof. Andrzej Lasia, *Emeritus Professor* at the Chemistry Department, Université de Sherbrooke, Québec, Canada

Wednesday, September 28st, 2022 : ASIS Day 2

09:00 - 10:15

Tutorial 7

Electrochemical Impedance Spectroscopy (EIS) for Electro-ceramic Materials and Systems

Dr. Dino Klotz, Application scientist at Zurich Instruments AG, Zürich, Switzerland

09:00 - 10:15

Tutorial 8

Instrumentation for insulin bioavailability assessment in diabetology. The use case of AD5940BIOZ

Prof. Pasquale Arpaia & Ms. Francesca Mancino, Dipartimento di Ingegneria Elettrica, Università di Napoli Federico II, Naples, Italy

10:15 - 10:30

Short break

10:30 - 11:45

Tutorial 9

Electrochemical characterization of immunosensor based on silicon technology using impedance spectroscopy

Prof. Abdelhamid Errachid, Professor at University Claude Bernard-Lyon 1, Lyon, France

11:45 - 13:00

Lunch break

13:00 - 14:15

Tutorial 10

Presenting Analytical Performances of Chemical and Biological Sensors: Experience Feedback

Prof. Najla Fourati, *Professor* at Cnam, SATIE Laboratory, UMR CNRS, Paris, France

14:15 - 15:30

Tutorial 11

Use of Impedimetric Sensors for Multifunctional Applications

Dr. Anindya Nag, Technische Universität Dresden, Dresden, Germany

15:30 - 15:45

Short break

15:45 - 17:00

Tutorial 12

Bionstrumentation Advances on Biosensing by Bioimpedance

Prof. Pedro Bertemes-Filho, *Professor* at Santa Catarina State University - UDESC, Santa Catarina, Brazil

17:00 - 18:00

Social event

IWIS Program

Thursday, September 29th, 2022 : IWIS day 1

08:15 - 08:45 **Opening**

08:45 - 09:45 **Plenary Talk 1**

Chair: Prof. Olfa Kanoun

Electrochemical Impedance Spectroscopy - an important tool, but?
; *Prof. Bernard Boukamp*

09:45 - 10:00 **Short break**

10:00 - 11:00 **Plenary Talk 2**

Chair: Prof. Bernard Boukamp

Advances on Differential Impedance Analysis ;
Prof. Daria Vladikova

Session 1 - Fundamentals

Chair: Prof. Bernard Boukamp

11:00 - 12:00

- Detection of non-linearity and non-stationarity in impedance spectra using an extended Kramers-Kronig test without overfitting;
Christian Plank et al.

- Investigation of complex electrical properties of concrete: A numerical model analysis; *Tanzila Nurjahan et al.*

- Time-frequency equivalence using chirp signals for electrochemical impedance spectroscopy; *Resmi Suresh et al.*

- Soft Fault Characterization for Predictive Maintenance in Complex Cable Structures; *Dhia Haddad et al.*

12:00 - 13:00

Lunch break & Exhibition & Hackathon Presentations

13:00 - 14:00

Plenary Talk 3

Chair: Prof. Daria Vladikova

Circuit Identification in Impedance Spectroscopy Applications ;
Prof. Pedro M. Ramos

14:00 - 15:00

Plenary Talk 4

Chair: Prof. Daria Vladikova

History, development, market and future of lithium ion batteries ;
Dr. Jürgen Heydecke

15:00 - 15:15 **Short break**

Session 2 - Energy

Chair: Dr. Jürgen Heydecke

- 15:15 - 16:15
- Scanning electrochemical microscopy for the characterization of fuel cell components; *Susanne Thiel et al.*
 - Study of EIS behavior of air-starved cells over different cell-counts in a PEM air-cooled stack; *Babak Ghorbani et al.*
 - Impedance Spectroscopy Analysis of a Thermo-electrochemical Cell Under Operating Conditions; *Sergio Castro-Ruiz et al.*
 - Mapping of the RedOx intercalation activity in 2D TMD flakes within Li-Ion-Batteries by 4-dimensional Raman Potentioelectrochemical Impedance Spectroscopy; *Mariusz Radtke et al.*

Session 3 - Bioimpedance

Chair: Pasquale Arpaia

- 15:15 - 18:00
- Using tissue-specific numerical models to estimate the dielectric properties of cartilage; *Julius Zimmermann et al.*
 - Electrical impedance spectroscopy on capacitively coupled electrodes for cartilaginous cell stimulation; *Henning Bathel et al.*
 - Effect of contact pressure on porcine postmortem brain tissue impedance; *Lucas Poßner et al.*
 - Meat Freshness Assessment based on Impedance Spectroscopy and Distribution of Relaxation Times (DRT); *Hanen Nouri et al.*
 - Anomalous charge transfer enhancement by Ru complex ions and its application; *Kazuyuki Nobusawa et al.*
 - Impedimetric sensors for monitoring bacterial contaminations in water pipes; *Margarita Guenther et al.*
 - Insulin absorption assessment based on bioimpedance measurements: model optimization for improving accuracy in clinical application; *Pasquale Arpaia et al.*
 - A comparison of impedance and antenna analyzers on the basis of machine learning assisted limit of detection experiments; *Ceyhan E. Kirimli et al.*
 - Use of the open-ended probe technique for the dielectric characterization of biological tissues at low frequencies.; *Flavia Liporace et al.*
 - Realistic 2D model of the human thorax for Electrical Impedance Tomography measurements; *Oumaima Bader et al.*

Session 4 - Materials (I)

Chair: Dr. Julia Linnemann

- 16:15 - 18:00
- Ideal Impedance Spectroscopy Equivalent Circuits for Thermoelectric Materials and Devices; *Jorge García-Cañadas et al.*
 - Characteristics of the SEI-layer formations on the Bi₂Se₃ anode in LiNO₃ and NaNO₃ solutions by electrochemical impedance spectroscopy; *Yelyzaveta Rublova et al.*
 - Comparative study of barium titanate-filled polyurethane and hydrogenated nitrile butadiene rubber as electroactive polymer composites; *Hans Liebscher et al.*
 - Effect of barium titanate particle filler in soft silicone films on their application in dielectric elastomer actuators; *Markus Koenigsdorff et al.*
 - Influence of polar solvents on Lead-Free BCZT based flexible nanogenerators performance; *Sarra Missaoui et al.*
 - Electrochemical Electrode Characterization with Impedance Measurements and Cyclic Voltammetry for Tracking Output Signal Drift; *Amina Brahem et al.*

Friday, September 30st, 2022 : IWIS Day 2

- 08:45 - 09:45 **Plenary Talk 5**
Chair: Dr. Najla Fourati
Beyond Electrochemical Impedance Spectroscopy: Advanced Methods for Studying the Dynamics of Electrochemical Processes ;
Dr.-Ing. Tanja Vidakovic-Koch
- 09:45 - 10:00 **Short break**
- 10:00 - 11:00 **Plenary Talk 6**
Chair: Dr.-Ing. Tanja Vidakovic-Koch
Elucidating operando-transformations of nanoparticulate electrocatalysts by electrochemical impedance spectroscopy ;
Dr. Julia Linnemann

Session 5 - AI and ML in EIS

- Chair: Dr. Julia Linnemann
- 11:00 - 12:00
- A hybrid method combining genetic and Nelder-Mead algorithms for the interpretation of electrochemical impedance data - application to Proton Exchange Membrane Fuel Cells; *Peizhe WU et al.*
 - Enhanced Particle Swarm Optimization for Electrical Impedance Tomography Image Reconstruction; *Oumayma Kahouli et al.*
 - Investigation of long short-term memory artificial neural networks as estimators of nitrate concentrations in soil from measured electrical impedance spectra; *Xiaohu Ma et al.*
 - Electrical Impedance Myography Measurements for Gesture Recognition Data Normalization; *Ayat Al Qudah et al.*
- 12:00 - 13:00 **Lunch break & Exhibition**
- 13:00 - 14:00 **Plenary Talk 7**
Chair: Prof. Uwe Pliquet
Impedimetric electronic nose/tongue for gas and liquid phases chemical sensing ; *Prof. Leonardo Giordano Paterno*

- 14:00 - 15:00 **Plenary Talk 8**
Chair: Jr.-Prof. Dr. Anindya Nag
Exploiting biomarker data for personalised Heart Failure patient management ; *Prof. Dimitrios I. Fotiadis*
- 15:00 - 15:15 **Short break**
- Session 6 - Materials (II)**
Chair: Dr. Thomas Keutel
- 15:15 - 16:00 - LaFeO₃ Dielectric Fired by Spark Plasma Sintering: First Experiences; *Pavel Ctibor et al.*
- Dielectric properties of lithium fluoride sintered after high-pressure forming; *Pavel Ctibor et al.*
- Dielectric Spectroscopy of Thallium-Doped Gallium Selenide Single Crystals Subjected To gamma-Irradiation; *Solmaz Mustafaeva et al.*
- Session 7 - Meas. Systems**
Chair: Prof. Jörg Himmel
- 15:15 - 16:00 - Estimating the Hot Rod and Wire Displacement in an Eddy-Current Sensor for Cross-Sectional Area Measurement; *Mario Radschun et al.*
- Frequency Spectroscopy of the Cross-Section Area of Hot Rods to Approximate Rolling Parameters; *Annette Elisabeth Jobst et al.*
- Electrical impedance spectroscopy for fouling detection in heat exchangers with earth connected working electrodes; *Felipe de Assis Dias et al.*
- 16:00 - 16:15 **Closure**

Publications series

O. Kanoun (Ed.)

Impedance Spectroscopy: Advanced Applications: Battery Research, Bioimpedance, System Design

Vol. 1, ISBN 978-3-11-055892-0, 2018

Progress Reports on Impedance Spectroscopy

Vol. 1, ISBN 978-3-11-044756-9, 2016

Lecture Notes on Impedance Spectroscopy: Measurement, Modeling and Applications

Vol. 5, ISBN 978-1-138-02754-1 (Hbk), 2015

Vol. 4, ISBN 978-1-138-00140-4 (Hbk), 2014

Vol. 3, ISBN 978-0-415-64430-3 (Hbk), 2012

Vol. 2, ISBN 978-0-415-69838-2 (Hbk), 2012

Vol. 1, ISBN 978-0-415-68405-7 (Hbk), 2011

Selected contributions from the IWIS 2022 will be published in the International Journal on Sensors and Instrumentation Systems, Inderscience.

