Chairman's Welcome Message

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

In its 13^{th} edition, the IWIS workshop includes 26 contributions from 11 countries in 9 sessions, 3 plenary talks, 4 and 7 tutorials. The peer reviewed contributions aim to 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 will take place. The TC-2 has been formed this year to promote Impedance Spectroscopy and standards within the IEEE community world wide.

The organization of the workshop has requested a considerable effort of the organizing team from the chair for measurement and sensor technology which makes it possible to organize this international event actually 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 2020.

Prof. Olfa Kanoun & Prof. Abdelhamid Errachid
General Chairs

IWIS 2020 Organizers

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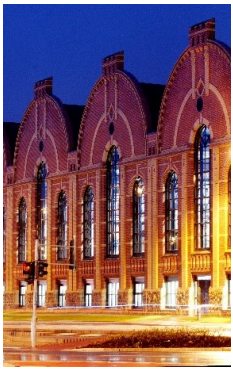
General Information

The City of Chemnitz

Chemnitz has its unique story - of groundbreaking 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 with a focus 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 with 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, Chemnitz as an important link in the global manufacturing chain, produces excellent machines and production facilities for the whole world.

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

Buildings in Jugendstyle in the famous Chemnitz-Kaßberg (4.5 km^2 protected area as a historic monument), (©www.chemnitz.de)

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 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 at the Campus of Chemnitz University of Technology. You can find it at:

Technische Universität Chemnitz
Neues Hörsaal und Seminargebäude (Orangerie)
Reichenhainer Straße 90
09126 Chemnitz

TU Chemnitz, Zentrales Hörsaal- und Seminargebäude (©www.chemnitz.de)

Workshops
This year, we are please to inform you about the fruitful workshops that will take place to discuss contemporary challenge an cutting-edge research problem, all while discussing fundamentals aspects in different applications, namely:

Workshop 1: Impedance of EVERYTHING: Understanding impedance spectra

Impedance spectroscopy provides an extensive insight on the processes, phenomena and material properties of an object-under-test. The complex impedance in function of the frequency includes separable and overlapping phenomena. For understanding the impedance spectrum, many methods have been developed, such as model based methods, mathematical and formal methods and transformation-based methods. In this workshop, we with experts discuss a. o. follwing questions:

- Are we applying the right signal processing methods?
- What happens if we make signal processing without knowing anough about the physical or chemical phenomena?
- What are today the available signal processing tools for impedance spectroscopy?
- To which dimension can it provide information?
- When can a model get the label of a real physical model?

Workshop 2: Secrets of Electrochemistry: Manifold material phenomena

The need for materials and detection of substances is increasingly gaining importance in science and technology. The use of impedance spectroscopy is thereby a fundamental part, in order to characterize materials and reactions and to demystify phenomena going upt the nano-scale, but also to monitor them during operation. In this workshop, we discuss with experts a. o. following questions:

- Can impedance spectroscopy characterize all these phenomena?

- What can an impedance spectrum tell us?
- To which dimension can it provide information?
- How to correctly interpret it?

Workshop 3: Battery in the first life cycle and beyond: Challenges for second life

Despite the extensive research in the field of batteries, identifying battery state for an optimal use is an open topic. Current standard techniques for assessing the state of charge or state of health of the battery are mostly dependent on offline full cycling and look-up-tables, which could be time-consuming and inconvenient in several applications. In this workshop, we discuss with experts a. o. following questions:

- To which degree are we really capable of accessing the batteries state in term of SoC and SoH?
- Can Impedance spectroscopy be applied online?
- How to assess a battery's capabilities for a first and second life use?
- Which prior knowledge is necessary for that?
- How long is the battery life really?

Workshop 4: Mystery of the human body: Bioimpedance

Bioimpedance measurement is a non-invasive method that having a high potential in health care. Measuring the bioimpedance starts with the choice of the electrodes and their positions, but also the excitation signals and the analog and digital signal processing. But, even after a good measurement procedure, a lot of questions remain open. In this workshop, we discuss with experts a. o. follwing questions:

- What did we exactly measure? Skin? Muscle tissue? Internal tissues? Bones?
- What are the influencing environment conditions

- How can we realize a medical approved wide-band excitation signals with a good signal power?
- Can we demistify the measurements in a correct manner
- Can Bioimpedance spectroscopy can be applied for wearable devices?

Sponsors

The workshop is supported by:

- School of Metrology CSM e.V.

- IEEE Instrumentation & Measurement Society

- IEEE IM Chapter Germany Section

- The main sponsor from industry:

Together with all the exhibitors listed in the next page

Exhibition

During the workshop, the following exhibitors will be present:

ASIS Program

Wednesday, December 2nd, 2020
Learning Day

08:30 - 09:20	**Tutorial 1** Basics on Electrochemistry, Phase Boundaries and Cell Potentials Prof. Roman Gruden, Industrial Automation, Duale Hochschule Baden-Württemberg Stuttgart, Germany
	Tutorial 2 Artefacts in Impedance Measurements: Tips and Tricks Dr. Wernez Strunz, Zahner-Elekrtik, Kronach, Germany
09:20 - 09:30	**Break**
09:30 - 10:20	**Tutorial 3** Impedance Basics: Choosing the Instrumentation Dipl. phys. Martin Bulst, Sciospec, Bennewitz, Germany
10:20 - 10:30	**Break**
10:30 - 11:20	**Tutorial 4** High-Resolution Impedance Sensing: Circuits, Instrumentation and Applications Prof. Marco Carminati, Politecnico di Milano, Dept. of Electronics, Information and Bioengingeering, Milano, Italy
11:20 - 11:30	**Break**
11:30 - 12:20	**Tutorial 5** Treatment of Non-ideal Circuit Elements in Time Domain Prof. Uwe Pliquett, Institut für Bioprozess- und Analysenmesstechnik e.V., Heiligenstadt, Germany
	Special issue module
12:20 - 13:00	**Lunch Break**

13:00 - 13:50 **Tutorial 6**
Basics on Equilibrium Electrochemistry
Prof. Leonardo G. Paterno, Laboratory of Research on Polymers and Nanomaterials - LABPOLN, Institute of Chemistry, University of Brasilia, Brazil

13:50 - 14:00 **Break**

14:00 - 14:50 **Tutorial 7**
Impedance of Porous Electrodes
Prof. Andrzej Lasia, Emeritus Professor at the Chemistry Department, Université de Sherbrooke, Québec, Canada

14:50 - 15:00 **Break**

15:00 - 15:50 **Tutorial 8**
Developing Low-Cost Bioimpedance Meter for Biomedical and Biological Applications
Prof. Pedro Bertemes Filho, Universidade do Estado de Santa Catarina, Dept. of Electrical engineering, Santa Catarina, Brazil

16:00 - 17:00 **IEEE TC-2 Impedance Spectroscopy Meeting**

IWIS Program

Thursday, December 3rd, 2020
Inspiration day

08:00 – 08:30	**Registration (Registration Desk)**
08:30 – 09:00	**Opening** Chair: Prof. Olfa Kanoun
09:00 – 10:00	**Plenary Talk 1** Chair: Prof. Olfa Kanoun 3D Impedance Spectroscopy to Investigate Electrochemical Reactions; *Dr. Eng. Masayuki Itagaki*
10:00 – 11:00	**Plenary Talk 2** Chair: Prof. Abdelhamid Errachid Monitoring Organ on a Chip with Impedance Spectroscopy: Application to Infection and Cancer; *Vincent Senez*
11:00 – 11:20	**Break**
11:20 – 12:10	**Workshop 1** Impedance of EVERYTHING: Understanding impedance spectra *Moderator: Hanen Nouri*
12:10 – 13:00	**Lunch Break**
13:00 – 13:50	**Workshop 2** Secrets of Electrochemistry: Manifold material phenomena *Moderator: Malak Talbi*
13:50 – 14:00	**Break**
14:00 – 14:50	**Workshop 3** Battery in the first life cycle and beyond: Challenges for second life *Moderator: Dr. Thomas Keutel*
14:50 – 15:00	**Break**
15:00 – 15:50	**Workshop 4** Mystery of the human body: Bioimpedance *Moderator: Bilel Ben Atitallah*
15:50 – 16:00	**Break**

16:00 – 17:00 **Plenary Talk 3**
Chair: Prof. Olfa Kanoun
Re-engineering the assessment of muscle through the use of electrical impedance technologies: from muscular dystrophy to Mars; *Dr. Seward Rutkove*

17:00 – 18:00 **Workshop**
Workshop of the DAAD Project: Generic Platform for the Design of Bioimpedance Spectrometer (BISMON)
Moderator: Dr. Dhouha Bouchaala, Dr. Sonia Bradai

Friday, December 4th, 2020
Exchange Day

08:30 – 09:00 **Come Together**

09:00 – 09:50 **IS in digital era: Impulse from day2's workshops & Hackathon Finalists**

Session 1 - Modelling of Impedance Data
Chair: Prof. A. Errachid

10:00 – 11:00 Analyzing Impedance Spectra with Probabilistic Distribution of Relaxation Times; *Francesco Ciucci et al*

Model of ZARC element with passive components; *Thomas Heil et al*

Substitutive Modeling of Sensor Structures of Arthropods on the Basis of Equivalent Circuit Models; *Andreas Mangler et al*

11:00 – 11:10 **Break**

Session 2 - Mechanisms and Phenomena
Chair: Dr. W. Strunz

11:10 – 12:10 Temperature Dependent Linear and Non-linear Electrochemical Impedance Spectroscopy Analysis to Elucidate the Solid Electrolyte Interface on Li Metal in Li/SOCl2 Batteries; *Mohammed Ahmed Zabara et al*

Study of Electrical Conduction Mechanism on Bipolar Resistive Switching Prussian White Thin Films using Electrical Impedance Spectroscopy; *Lindiomar Borges de Avila Junior et al*

An EIS Study Focused on Low Frequencies for Li-ion Batteries Using Blocking Cell Configuration; *Wonhee Kim et al*

12:10 – 13:00 **Lunch Break**

Session 3 - Material for Energy Harvesting & Storage

Chair: Prof. N. Wagner

13:00 – 14:00 Electrochemical impedance spectroscopy for complex studying lithium-conductive composite membranes; *Nikita Akhmetov et al*

Impedance spectroscopy for Solar Cells: Electrical Properties of Nanostructured Electrodes Based on Aluminium Doped Zincite; *Arijeta Bafti et al*

Fostering Piezoelectric Performance of Flexible Nanogenerators using Zn Doped Ba 0.85 Ca 0.15 Zr 0.1 Ti 0.9 O 3; *Amina Ben Ayed et al*

Session 4 - Sensor Systems

Chair: Prof. U. Pliquett

13:00 – 14:00 VOC sensing with AI signal processing based on sensor fusion; *Julian Ramon Eise et al*

Single-cell microfluidic impedance cytometry meets neural networks; *Federica Caselli et al*

Nanochannel-based Resistive Pulse Sensing Device for Label-free Biomolecule and Bionanoparticle Analysis; *Ziyu Han et al*

Session 5 - Electrochemical Sensors

Chair: Prof. Leonardo Paterno

13:00 – 14:00 Adsorption of halides on Au (111) electrode in aprotic solvents: AC-voltammetry and EIS; *Ahmed Shatla et al*

PANI-CNT based electrochemical sensor for 4-Aminophenol; *Salem Nasraoui et al*

14:00 – 14:10 **Break**

Session 6 - Smart Materials

Chair: Dr. Ayda Bouhamed

14:10 – 15:30 Solid State Impedance Spectroscopy Study Bioglass 45S5 Doped with Fe; *Marta Razum et al*

Impedance Spectroscopy of nanostructured ZnO morphologies; *Rusiri Rathnasekara et al*

Comparative Study Between Different Lead-free Ferroelectric Nanoparticles to Boost the Performance of Flexible Nanogenerators; *Khawla Jeder et al*

Session 7 - Biomedical Impedance

Chair: Prof. P. Bertemes-Filho

14:10 – 15:30 Impedance Properties of Trabecular Bone Based on Different Analytical Methods; *Wenzuo Wie et al*

In-situ measurement of skin impedance as a function of body temperature using impedance spectroscopy; *Sven Cecchetti et al*

In-situ measurement of skin impedance for the analysis of the influence of cortisol on the barrier function of the skin using impedance spectroscopy; *Andre Keller et al*

Examination and Evaluation of Surfactant Impacts on Skin Hydration with Impedance Spectroscopy et al; *Nora Shahin et al*

Session 8 - Gesture Recognition

Chair: Rajarajan Ramalingame

14:10 – 15:30 Comparative of Binary Swarm Optimization based Wrappers for EMG Feature Selection et al; *Hiba Hellara et al*

Hand Gesture Recognition based on Electrical Impedance Tomography Measurements using Genetic Algorithms; *Mariem Hafsa et al*

Portable low-cost EIT system for multi measurement purposes; *Zheng Hu et al*

Notes:

Notes:

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 2020 will be published in the International Journal on Sensors and Instrumentation Systems, Inderscience.