ISSE

15 - 19 May 2024 Prague, Czech Republic

International Spring Seminar on Electronics Technology

Trends in Electronics Manufacturing, Interconnection Technology, and Microelectronics Packaging

CONFERENCE PROGRAM & EXTENDED ABSTRACTS

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ISSE 2024

47th International Spring Seminar on Electronics Technology

"Trends in Electronics Manufacturing, Interconnection Technology and Microelectronics Packaging"

May 15 – 19, 2024, Congress Center of the Institute of Molecular Genetics, Prague, Czech Republic

Conference Program
&
Extended Abstracts

1 st Edition 2024

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Preface

The organizers of the 47th International Spring Seminar on Electronics Technology welcome all attendees of the ISSE 2024, in Prague. The conference event begins on Wednesday, May 15th, with a welcome reception in the afternoon and includes three full conference days with six oral sessions and five poster sessions in the traditional in-person format. The plenary sessions will take place at the Institute of Molecular Genetics of the Czech Academy of Sciences, and the social program will provide a Prague city guided tour, Strahov Monastery and Library guided tour.

The International Spring Seminar on Electronics Technology (ISSE) is the premier European forum for exchanging information between senior and young scientists from academic communities and electronic industries worldwide. Topics include experimental and theoretical work in a widespread field of electronics and micro/nanoelectronics technology, electronics manufacturing, electronics packaging, advanced research, and teaching. Based on a combination of oral and poster presentations and individual meetings, professors, industrial participants, students, senior and junior researchers come together in a unique forum to discuss scientific and educational topics and organize international cooperation in a convenient atmosphere during the conference days.

This Book of Abstracts is meant to provide an overview of the whole technical scope of the conference and to support orientation during the conference. For this reason, the abstracts are ordered according to the sequence of the conference topic.

The local organizer, Department of Electrotechnology, Faculty of Electrical Engineering, Czech Technical University in Prague, was supported in conference organization by companies: Continental Automotive Czech Republic (main sponsor), Rohde & Schwarz (main sponsor), Infineon Technology Austria AG, Valeo, Vyrtych and IBG Czech.

The organizers would like to take the opportunity to express their particular gratitude to

- all participants for their valuable scientific contributions and presentations
- all reviewers for their help to achieve an internationally recognized scientific level
- all sponsors for supporting the organization of the conference
- and the IEEE EPS for its technical co-sponsorship

Acknowledgements are also directed to all colleagues, friends and ISSE members who helped with the conference organization.

The organizers wish all attendees a pleasant and successful conference!

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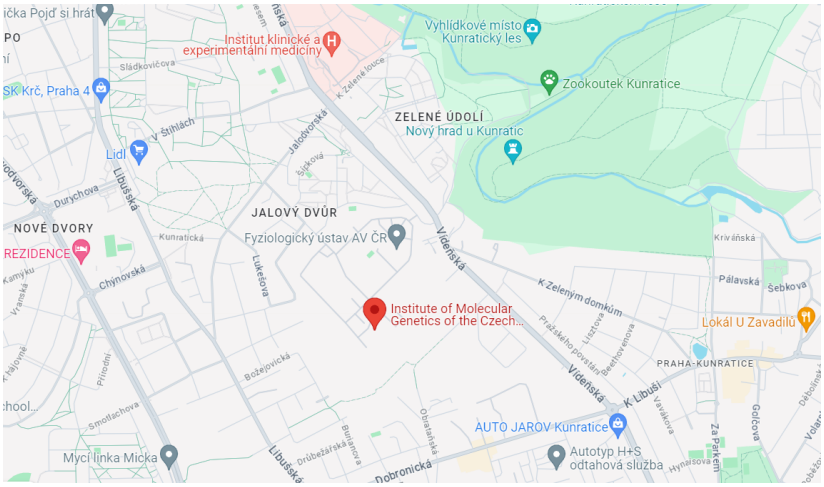
History of ISSE

ISSE is a series of annual conferences on electronics packaging that was founded in 1977 to provide a European forum senior and junior scientists as well as electronic industries around the world.

1st	1977	Application of Mathematics in Electronics Technology, Weissig, Germany
2nd	1978	Reliability in Electronics, Prenet, Czechoslovakia
3rd	1979	Measurements in Electronics Technology, Balatonfüred, Hungary
4th	1980	Hybrid Technology, Manebach, Germany
5th	1982	Physical Measuring Methods, Prenet, Czechoslovakia
6th	1983	Research and Education in Microelectronics, Balatonfüred, Hungary
7th	1984	Applications of Microprocessors in Technology, Geising, Germany
8th	1985	Power Semiconductors, Hybrid Devices, Prenet, Czechoslovakia
9th	1986	Progress in Physical Measuring Methods on Electronics Technology, Balatonfüred, Hungary
10th	1987	Progress in Education in Hybrid Microelectronics, Sozopol, Bulgaria
11th	1988	Progress in Surface Mount Technology, Karsdorf, Germany
12th	1989	Thermal Problems in Electronics Technology, Prenet, Czechoslovakia
13th	1990	Computer Aided Electronics Technology, Göd, Hungary
14th	1991	Total Quality Control in Hybrid Production, Sozopol, Bulgaria
15th	1992	Higher Education in Electronic Technology, Herlany, Slovak Republic
16th	1993	Thick and Thin Film Sensors, Szklarska Poreba, Poland
17th	1994	Process Technology of Electronics, Weissig, Germany
18th	1995	Advanced Electronics Technology, Temesvár, Czech Republic
19th	1996	Advanced Electronics Technology, Göd, Hungary
20th	1997	Education and Research in Microelectronics, Szklarska Poreba, Poland
21st	1998	Advanced Electronics Technology, Neusiedl am See, Austria
22nd	1999	Driving Forces in Electronics Technology, Freital, Germany
23rd	2000	Networking Electronics Packaging Education, Balatonfüred, Hungary
24th	2001	Concurrent Engineering in Electronic Packaging, Calimanesti-Caciulata, Romania
25th	2002	Quality Management and Diagnostics in Electronics Packaging, Prague, Czech Republic
26th	2003	Integrated Management of Electronic Materials Production, High Tatras, Slovak Republic
27th	2004	Meeting the Challenges of Electronics Technology Progress, Bankia / Sofia, Bulgaria
28th	2005	European Electronic Packaging Network, Wiener Neustadt, Austria
29th	2006	Nano-Technologies for Electronics Packaging, St. Marienthal/Dresden, Germany
30th	2007	Emerging Technologies for Electronics Packaging, Cluj-Napoca, Romania
31st	2008	Reliability and Life-time Prediction, Budapest, Hungary
32nd	2009	Technology Integration, the path to New Solutions in the Modern Electronics, Brno, Czech Republic
33rd	2010	Polymer Electronics and Nanotechnologies: Towards System Integration, Warsaw, Poland
34th	2011	New Trends in Micro/Nanotechnology, Tatranská Lomnica, Slovak Republic
35th	2012	Power Electronics, Bad Aussee, Austria
36th	2013	Automotive Electronics, Alba Iulia, Romania
37th	2014	Advances in Electronic System Integration, Dresden, Germany
38th	2015	Novel Trends in Electronics Manufacturing, Eger, Hungary
39th	2016	Printed electronics and smart textiles, Pilsen, Czech Republic
40th	2017	High-Tech Electronics for a Better Tomorrow - Theoretical and Practical Aspects, Sofia, Bulgaria
41st	2018	Research and Development Tendencies in Advanced Electronics Technologies, Zlatibor, Serbia
42nd	2019	Advances in Printed and Ceramic Microsystems, Wroclaw, Poland
43rd	2020	Trends in Microelectronics Packaging and Interconnection Technology, Kosice, Slovakia
44th	2021	Advancements in Microelectronics Packaging for Harsh Environment, Dresden, Germany
45th	2022	Electronics Technology Innovations towards Green Electronics, Vienna, Austria
46th	2023	Revolutionizing the Electronics Ecosystems – Chiplet and Heterogeneous Integration, Timișoara, Romania

Conference Venue

Institute of Molecular Genetics of the Czech Academy of Sciences, address: Videnska 1083, 142 20 Prague 4, Czech Republic.



Conference Program

Wednesday, 15th of May		
15:00	Arrival, registration, accommodation	**Location: Residence Emmy Hotel**
19:00	**Welcome Party**	**Location: Conference Venue**
21:00	**Steering Committee meeting**	**Location: Auditorium 0.195**

Thursday, 16th of May		
08:30	**Opening session of ISSE 2024**	**Location: Milan Hasek Auditorium**
	Welcome speech Oliver Krammer and Karel Dusek	
08:45	**Oral session I chaired by: O. Krammer and K. Dusek**	**Location: Milan Hasek Auditorium**
KN01	**10 Golden Rules of Chip- Package- Board Interactions** Evelyn Napetschnig (Infineon Technologies AG)	
KN02	**Technological Status Quo for High-end RF Printed Circuit Board Development at Rohde&Schwarz** Franz Röhrl (Rohde&Schwarz)	
D32	**Electrochemical Migration: Evaluating the Effect of Fe2O3 Nanoparticle Incorporation on the Reliability of SAC Alloys** Ali Gharaibeh (Budapest University of Technology and Economics)	
D53	**Assessing Impact of Creep and Random Vibration on BGA Solder Interconnects Through Finite Element Analysis (FEA)** Sabuj Mallik (Buckinghamshire New University)	
D102	**Adhesion measurements of polyimide to SixNy for semiconductor component applications** Moritz Hartleb (KAI Kompetenzzenturm Automobil- und Industrieelektronik GmbH)	
10:45	**Coffee break**	
11:00	**Oral session II chaired by: P. Mach and J. Nicolics**	**Location: Milan Hasek Auditorium**
KN03	**Chiplet Design and Heterogeneous Integration Packaging** John H Lau (Unimicron Technology Corporation)	
B37	**Thermal Diffusivity of a Multilayer Structure** Corina Ruxandra Mitulescu (National University of Science and Technology Politehnica Bucharest)	
C46	**Experimental Study of a Novel Printed Circuit Board Interconnection Technology** Karamat Adavi (Huber Automotive AG)	
12:30	**Lunch**	**Location: Conference Venue**
13:30	**Poster session I chaired by: R. Kisiel and H. Wohlrabe**	**Location: Milan Hasek Auditorium, Exhibition Hall**
D01	**Power Cycling Lifetime Improvement in Aluminum Wire Bonding Process** Hyeon Min Jeong (Infineon)	
D03	**How Different Cleaning Procedures Affect Reliability of Conductive Joints on E-Textiles** Martin Hirman (University of West Bohemia)	
D04	**Moisture Resistance Enhancing of E-Textiles** Martin Hirman (University of West Bohemia)	

D07	**Electrochemical Migration Resistance of Gold Surface Finishes** Marketa Klimtova (Czech Technical University in Prague)	
D17	**Development of Sensor Emulators for Testing the Safety Mechanisms of Sensor Interfaces in Automotive Electronics** Nicolae Gross (University Politehnica of Bucharest)	
D21	**Analysis of Electronic Modules for Construction Machines and Development of a Reliability Test Method** Max Häusler (Technical University of Dresden)	
D23	**Design of a Flat Coil Electrothermal Vaporization Device for Inductively Coupled Plasma Optical Emission Spectrometry** Petr Vesely (Czech Technical University in Prague)	
F12	**3D Printed Circuit Boards from Recycled Plastics: Interconnection Properties** Jakub Zdrahal (Czech Technical University in Prague)	
F18	**Hydrogen in Automotive: LCA Study** Michael Fridrich (Czech Technical University in Prague)	
F28	**Towards Sustainable Electronics: Unveiling the Nexus of Circular Economy, Global Policies and Industry Impacts** Andrea Benesova (University of West Bohemia)	
F47	**Soil Degradation of Sustainable PLA/Flax Substrates and Printed Circuit Board Assemblies** Csaba Farkas (Budapest University of Technology and Economics)	
F74	**Biodegradable Comb Sensor Based on 3D Printed Conductive Polylactic Acid** Peter Lukacs (Technical University of Kosice)	
F92	**Sustainability in Electronics - Testing Sensors with Polycarbonate Housing (PC) vs Poly Lactic Acid Housing (PLA)** Ioan Szabo (University Politehnica of Bucharest)	
F99	**Increasing productivity in vapour phase soldering using stack-mode** Gergo Havellant (Budapest University of Technology and Informatics)	
F108	**Sustainability Challenges: The Circular Economy Dilemma in Lithium-Ion Battery Cell Electrochemical Discharging Processes** Anna Prazanova (Czech Technical University in Prague)	
15:00	**Coffee break**	
15:15	**Oral session III chaired by: S. Stoyanov and E. Ceuca**	**Location: Milan Hasek Auditorium**
KN04	**Soldering defects and their arduous solution in PCB assembly at Rohde & Schwarz** Vaclav Wirth (Rohde&Schwarz)	
E43	**Distributed System Using Synthetic Data of Lithium-ion Battery Digital Twin for Battery Diagnosis** Eliza M Olariu (Technical University of Cluj Napoca)	
E95	**Study of Thermal Loading of Ceramic Capacitors during Reflow Soldering** Steffen Wiese (Saarland University)	
E98	**Knowledge Mining using Generative AI for Causal Discovery in Electronics Production** Sven Meier (Friedrich-Alexander-University Erlangen-Nürnberg)	
16:45	**Coffee break**	
17:00	**Poster session II chaired by: K. Nieweglowski and B. Mihailescu**	**Location: Milan Hasek Auditorium, Exhibition Hall**
A02	**Towards Additively Manufactured Alumina Substrates for Printed Electronics Applications** Martin Janda (University of West Bohemia)	

A19	**3D printing Conductive Pastes Based on Polystyrene/Graphite Composite** Iva Kralova (Czech Technical University in Prague)
A22	**Development and Application of a Wireless, in Body Data Acquisition System for Observation of Experimental Rabbit's Bone Healing** Jonas Uricar (Czech Technical University in Prague)
A36	**The Effect of Oxide Reduction Using Formic Acid Vapours on The Thickness of The Conductive Layer** David Michal (University of West Bohemia)
A44	**NTC Thermistor Ferrite Composite for Temperature Sensing with Reduced Humidity Influence** Maria Nikolic (University of Belgrade)
A45	**Effect of electro(less) plating on mechanical and geometric properties of polymer-metal structures based on 3D printed models** Radek Tucek (Czech Technical University in Prague)
A48	**Stretchability of Printed Conductive Structures for Thermoformable Structural Electronics** Adam Urban (University of West Bohemia)
A49	**Design of a Flat Coil Electrothermal Vaporization Device for Inductively Coupled Plasma Optical Emission Spectrometry** Patarau Toma (Tehnical University of Cluj Napoca)
A87	**Printed Piezoelectric Harvester for Integration in a Wearable Energy Storage Device** Mariya Aleksandrova (Technical University of Sofia)
A118	**Thick-film CuNi-Ag and CuNi-Cu Thermocouples and Thermoelectric Microgenerators** Andrzej Dziedzic (Wroclaw University of Science and Technology)
A119	**Thick_Film Thermoelectric Structures Based on Ca3Co4O9-Ag and Ca2.7Bi0.3Co4O9-Ag Thermopiles** Andrzej Dziedzic (Wroclaw University of Science and Technology)
H14	**A Dual-Band Wilkinson Power Divider Using Compact Lowpass Filter with Wide Suppression Band** Saeedeh Lotfi (University of West Bohemia)
H15	**Design of a Quadrature Hybrid Coupler with Triple Tapered Resonators** Saeedeh Lotfi (University of West Bohemia)
H16	**Design of Ultra-wide Stopband Lowpass Filter based on Compact Microstrip Resonator Cells** Saeedeh Lotfi (University of West Bohemia)
H85	**Textile-Based Flexible Coaxial Cable** Jan Handrejch (University of West Bohemia
19:00	**Dinner** — **Location: Conference Venue**

	Friday, 17th of May	
08:30	**Oral session IV chaired by: A. Geczy and J. Morris**	**Location: Milan Hasek Auditorium**
KN05	**Contrasting Reliable Systems – Automotives and Mobiles** Nihal Sinnadurai (Advanced Technology Transfer Associates)	
KN06	**Component packages and their influence on the climatic reliability of assemblies** Vladimir Sitko (PBT Works)	
A58	**Additively Printed Heating Structure for Radome De-icing Application** Kok Siong Siah (Institute for Factory Automation and Production Systems at Friedrich-Alexander-Universität Erlangen-Nürnberg)	
A71	**Laser powder bed fusion of titanium alloyed copper powder for power electronic substrates** Christoph Hecht (Friedrich-Alexander-Universität Erlangen-Nürnberg)	
10:30	**Coffee break**	

10:45	**Poster session III chaired by: A. Dziedzic and M. Kisic**	**Location: Milan Hasek Auditorium, Exhibition Hall**
I05	**Development an Ultra-Low Power "Coin" Size Sensor** Elitsa E Gieva (Technical University of Sofia)	
I26	**Design and Implementation of an Electronic Encryption System based on PCA algorithm** Petre Anghelescu (National University of Science and Technology Politehnica Bucharest)	
I29	**Thermal Junction of NTC Chip Thermistors** Milan Bodic (Faculty of Technical Sciences Novi Sad)	
I30	**Differential thermal voltammetry for states-of-health (SOH) estimation of Li-ion batteries** Miroslav Mikolasek (Slovak University of Technology)	
I31	**Evaluation of semipermeable membranes for encapsuling gas sensors in human intestinal environments** Felix Stadermann (Institute for electronics packaging - TU Dresden)	
I38	**Realization of Cost-Effective Supercapacitors Utilising Substitutable Materials** Irina Madalina Burcea (National University of Science and Technology Politehnica Bucharest)	
I40	**Highly Elastic Textile Conductive Ribbons as Frequency Resonators for Wearable Strain Monitoring** Michaela Radouchova (University of West Bohemia)	
I42	**Modelling and Simulation of a Two-Stage Grid-Connected MPPT Inverter** Patarau Toma (Tehnical University of Cluj Napoca)	
I56	**Evaluating the Performance of Measurements Systems Using Data Processing Methods Based on Kalman Filter** Alexandru F Flutur (Technical University of Cluj-Napoca)	
I63	**Multifunctional Inkjet-Printed Silver Structures for Wearable Biosensors** Rade Tomov (Technical University of Sofia)	
I70	**A TeraRanger One based LiDAR** Pena D Madalina (1 Decembrie 1918 University Alba Iulia)	
I80	**Design of navigation system with wireless connectivity** Rosen Miletiev (Technical University of Sofia)	
I82	**3-axis Accelerometer IMU in Various Degrees of Freedom Multi-switch Button Array** Slavomir Kardos (Technical University of Kosice)	
I83	**Nitrogen Dioxide Sensor based on Organic Electrochemical Transistor** Josef Slauf (University of West Bohemia)	
I89	**Noise Measurement System Based on Cross-Correlation Method** Ana Cristina Davidas (Technical University of Cluj-Napoca)	
I96	**Electronic Nose Based on AI-capable Sensor Module for Beverages Identification** Attila Géczy (Budapest University of Technology and Informatics)	
I111	**Stretchable Strain Sensor using Interdigitated Capacitor on Fabric** Milica Kisic (University of Novi Sad)	
I112	**Influence of Number of Turns on Common-Mode Choke's Characteristics** Mirjana Damnjanovic (University of Novi Sad)	
I122	**Master-Slave BMS Architecture with CAN-bus for Inter-Cell Communication** Lucian Perisoara (University Politehnica of Bucharest)	
12:30	**Lunch**	**Location: Conference Venue**
13:30	**Oral session V chaired by: P. Lukacs and A. Tulbure**	**Location: Milan Hasek Auditorium**
KN07	**AI in production – Magic AOI** Jakub Altman (Continental)	
A104	**Flexible Frequency Selective Surfaces** Olga Rac-Rumijowska (Wrocław University of Science and Technology)	
A113	**Influences on the Mechanical Strength of Inkjet-Printed, Ag-Nanoparticle-Based Interconnects of Ni-Ag Finished Fine-Pitch Components** Christian Voigt (Friedrich-Alexander-University Erlangen-Nürnberg)	
H10	**Propagation Delay Analysis by Employing Various PCB Manufacturing Process** Jae-Ho Choi (Samsung Electronics)	

16:00	**Social program**	
19:00	**Dinner**	**Location: Strahov Monastery**
21:00	**Social program**	

Saturday, 18th of May		
09:00	**Poster session IV chaired by: T. Blecha and F. Steiner**	**Location: Milan Hasek Auditorium, Exhibition Hall**
D24	**Development of Computationally Efficient Numerical Models for Assessing the Reliability of Electronic Components under Vibration Loads** Chengzhe Lyu (Technical University of Dresden)	
D33	**Effect of New Types of PCB Surface Finishes on Fractographic Morphology of Solder Joints** Daniel Dzivy (Technical University of Kosice)	
D41	**Effect of TiO2 Nanoparticles Addition on the Electrochemical Migration of Lead-Free Sn-Bi Alloys** Ali Dayoub (Budapest University of Technology and Economics)	
D50	**Occurrence of Voids in Soldered Joints for Electrical Engineering** Tomas Chvosta (Czech Technical University in Prague)	
D59	**The Use of Scatter Plot Charts for the Study of Changes in the Electrical Parameters of Conductive Adhesive Joints** Pavel Mach (Czech Technical University in Prague)	
D60	**Effect of Post-Annealing on Electrical Parameters of Joints Formed from Conductive Adhesive** Pavel Mach (Czech Technical University in Prague)	
D61	**Influence of Reflow Temperature Profile on the Intermetallic Layers Thickness at Different Surface Finishes** Karel Dusek (Czech Technical University in Prague)	
D64	**Effect of Manufacturing Technology on Polymer Thick-film Resistors in 3D Printed Structures** Igor Vehec (Technical University of Kosice)	
D66	**Lithium-Ion Cell and Battery Testing by Spectral Analysis** Krasimir Kishkin (Technical University of Sofia)	
D67	**Effects of Thermal Cycling and PCB Substrate Type on Reliability of Solder Joints** Daniel Fros (Czech Technical University in Prague)	
D68	**Board Level Underfill – Moisture Related Voids** Zbynek Plachy (Czech Technical University in Prague)	
D76	**Electrical Properties' Stability of Flexible Carbon-Based Conductive Layers** Peter Lukacs (Technical University of Kosice)	
D79	**Utilization of microextraction-gas chromatography coupled to mass spectrometry for characterization of electrotechnology materials** Dominik Pilnaj (Czech Technical University in Prague)	
D81	**Stability of OhmegaPly Resistors with Different Shapes** Tomas Lenger (Technical University of Kosice)	
D88	**Analyzing the Impact of Surface Treatment on Solder Joint Voids** Pavel Rous (University of West Bohemia)	
D94	**The Use of Bending Experiments for the Efficient Characterization of the Mechanical Functionality of Component Interconnections** Erik Wiss (Saarland University)	
D105	**Variations in Open Circuit Voltage of Cycle-Aged Lithium-Ion Batteries due to Silicon-Enhanced Anodes** Michele Galasso (Czech Technical University in Prague)	
D117	**The set-up for Seebeck coefficient characterisation of film materials** Piotr M Markowski (Wrocław University of Science and Technology)	
D123	**An Expired Solder Paste vs Fresh Solder Paste: Reliability and Sustainability in Electronics Manufacturing** David Busek (Czech Technical University in Prague)	

10:30	**Coffee break**	
10:45	**Poster session V chaired by: E. Gieva and M. V. Nikolic**	**Location: Milan Hasek Auditorium, Exhibition Hall**
E06	**Intra-Day Optimal Dispatching of an Islanded Microgrid under Solar Power Uncertainty** Nicolae A Sarbu (Technical University of Cluj-Napoca)	
E09	**Modelling the Effect of Laser-Trimming on the Electrical Properties of Thick-film Resistors** Oliver Krammer (Budapest University of Technology and Economics)	
E27	**Active balancing of Li-ion battery cells using the DC2100B-C and DC2100B-D module** Mirela Olteanu (Technical University of Cluj-Napoca)	
E39	**Investigation of Sn grain growth in solder joints by numerical simulations** István Bozsóki (Budapest University of Technology and Economics)	
E54	**Reliability Meta-modelling of Power Components** Stoyan Stoyanov (University of Greenwich)	
E57	**Optimal Resource Scheduling for a Greenhouse Powered by an Islanded Microgrid** Nicoleta Stroia (Technical University of Cluj-Napoca)	
E97	**Modelling of Battery Management System based on Switching Capacitors** Dimitar Arnaudov (Technical University of Sofia)	
E103	**FCCSP Warpage Scope Evaluation for 5G Product with Advanced Wafer Node** TzuChi Zeng (Siliconware Precision Industries)	
E107	**State-of-Charge Estimation Based on Open-Circuit Voltage Model Considering Hysteresis** Vaclav Knap (Czech Technical University in Prague)	
E116	**Simulation of Electrochemical Heating in Li-Ion Batteries** Jan Zemen (Czech Technical University in Prague)	
B55	**A Simple and Cost-Efficient Method for Lithium-ion Battery Thermal Parameter Identification** Faisal Rehman (Czech Technical University in Prague)	
C11	**Low Temperature Adhesive Die Bonding for Sensitive MEMS Dies** Lukas Lorenz (Fraunhofer Institute for Photonic Microsystems)	
C110	**Silver Sintering Application in Packaging Al Metallized Chip onto Au Metallized Substrates** Marcin Mysliwiec (Warsaw University of Technology)	
G25	**Iron Nanoparticle-Doped Flux: Wetting Characteristics of Flux and SAC305 Solder and Effects on Flux Viscosity** Irina Wodak (TU Wien)	
G73	**TCAD model of GAA Nanowire Transistor with silicon oxide/nitride/oxide dielectric** Rostislav Rusev (Technical University of Sofia)	
G75	**Investigation of In-Situ Polymerization in Nanocomposites** Alexandra Borok (Budapest University of Technology and Economics)	
G84	**Detection of Nucleotides Using Gold Nanoprisms Immobilized on Glass** Nora Tarpataki (Budapest University of Technology and Economics)	
G86	**Modeling the Optical Response of a Periodic Nanoparticle Arrangement with the Finite Element Method** Rebeka Kovacs (Budapest University of Technology and Economics)	
G121	**Investigation of Polymer Nanocomposites Doped with Gold Nanorods and Alexa Fluor Indicator Molecules with Raman Spectroscopy** Shereen Zangana (Budapest University of Technology and Economics)	
J90	**Training Cost Analysis on a Large Computer Vision Ceramic Defect Detection Model** Adrian V Tulbure ("1 Decembrie 1918" University of Alba Iulia)	
12:30	**Lunch**	**Location: Conference Venue**
13:30	**Oral session VI chaired by: P. Markowski and D. Busek**	**Location: Milan Hasek Auditorium**
I62	**Portable Device for In-Situ Cyclic Voltammetry Measurements** Mitar Simic (University of Novi Sad)	
F65	**Unlocking Insights: A Systematic Survey of Material Composition in Lithium-Ion Battery Cells for Recycling Solutions** Jan Koci (Czech Technical University in Prague)	

14:15	Closing ceremony – invitation to ISSE 2025	Location: Milan Hasek Auditorium
14:45	Social program	
18:00	Steering committee meeting	Location: Milan Hasek Auditorium
19:00	Awarding ceremony	Location: Conference Venue
19:30	Dinner	Location: Conference Venue

Sunday, 19th of May		
09:00	Farewell; End of conference	

Contents

NTC Thermistor Ferrite Composite for Temperature Sensing with Reduced Humidity Influence

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Summary: Negative temperature coefficient (NTC) thermistor semiconducting oxides, such as ferrites used as resistance-based temperature sensors, remain in research focus, as they are basic building blocks of many electronic systems. In this work we have investigated NTC thermistor properties of a ferrite composite ($MnFe_2O_4/Fe_2O_3$) ceramics obtained by solid-state sintering in the form of a bulk sample with a diameter of 8.7 mm and thickness of 1.8 mm. We obtained a thermal (material) constant ($B_{10,90}$) of 4390 K from measured impedance at 100 Hz in the temperature range 10 - 90 °C and temperature sensitivity (α) of -4.87 %/K at 25 °C, that was within the range required for a commercial NTC thermistor material (B between 2000 and 5000, α between -2 and 6% K at room temperature -25 °C). The influence of relative humidity (RH) in the range 30-90% at 25 and 50 °C on impedance in the frequency range 50 Hz – 1 MHz was monitored. The obtained results showed that at 100 Hz the change in impedance was from 8.15 to 3.56 MΩ at 25 °C and 2.81 to 1.65 MΩ for RH from 30 to 90%, indicating that the humidity influence was reduced compared to other NTC thermistor materials. Future work will focus on applying this ferrite composite in flexible printed temperature sensors.

Keywords: Temperature sensing, NTC thermistor, ferrite composite, humidity.

Motivation

Temperature sensors used for measuring temperature changes are an essential component in most industries and in everyday life. They are used to monitor temperature in different industrial machinery, the working environment, domestic appliances, medical applications and many others. Negative temperature coefficient (NTC) thermistors remain a good solution for detecting small temperature changes and they are widely applied as temperature sensors in a wide range of electronic system [1]. The operating principle of a NTC thermistor semiconducting material is that its resistivity decreases with increase in temperature. Semiconducting metal oxides including ferrites remain in focus as potential NTC thermistor materials in the field of printed sensors, and have potential for application in flexible temperature sensors [2, 3]. Humidity has significant influence on sensor performance, including NTC thermistors, as increased humidity commonly leads to decrease in resistivity resulting in lower sensor sensitivity. Development of sensing materials that are insensitive to humidity or this influence is small can be of considerable significance. The basic characteristic parameters of a NTC thermistor material are the material constant (B in Kelvin) and temperature sensitivity at room temperature (commonly 25 °C). The material (thermistor) constant (B) in a certain temperature interval is determined from the Arhenius equation that is generally used to model the resistance decrease with temperature growth [4]. Commercial thermistors generally have a B value between 2000 and 5000 and sensitivity between -2 and -6 %/K.

Results

Fig. 1 shows the measured change in impedance in the temperature range 10 – 90 °C, frequency 50Hz – 1 MHz, calculation of the material constant at 100 Hz, and the influence of change in relative humidity on change in impedance at 25 and 50 °C at 100 Hz.

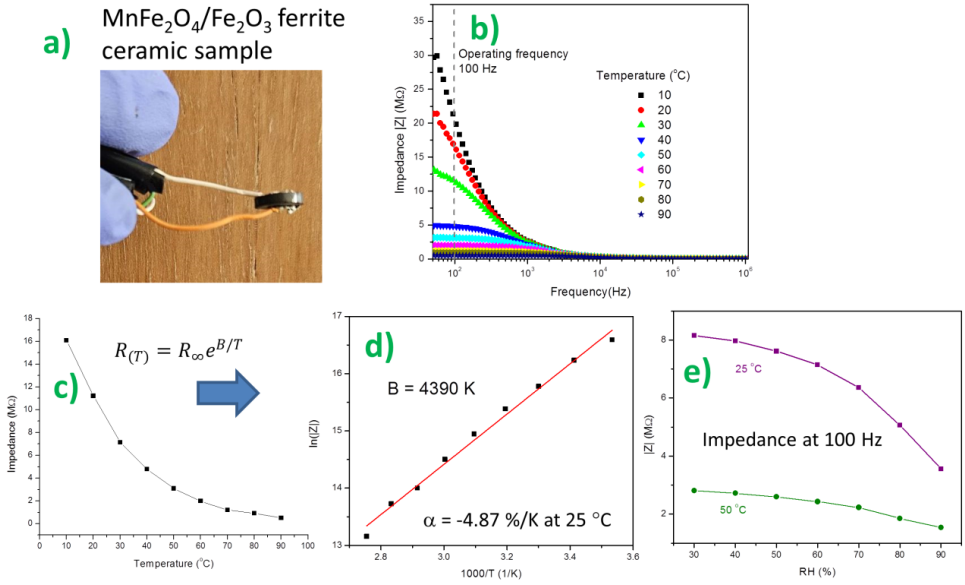

Fig. 1: $MnFe_2O_4/Fe_2O_3$ ceramic sample (a) change in impedance with frequency and temperature (b), dependence of impedance at 100 Hz on change in temperature (c), linear fit using the Arhenius equation (d) and change in relative humidity (RH) measured at 25 and 50 °C (e).

Acknowledgement

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