

# Final Program

## 67<sup>th</sup> IEEE Holm Conference on Electrical Contacts



23-26 OCTOBER 2022  
Westin Tampa Waterside  
Tampa, Florida, USA



**IEEE**



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## 2022 Awards Committee

Committee

Gerald Witter  
Koichiro Sawa  
Siegfried Fouvry

## 2022 Prize Paper Award Committee

Guang Yang  
Deepak Patil  
Diego Gonzalez

## Purpose

To provide a forum for the presentation and discussion of the latest developments in the field of electrical contacts, as well as the application of recent advances in materials and processes in electrical, electronic and telecommunications equipment.

## For Whom

Practicing designers, engineers, physicists, and research scientists—those new to the field and those experienced. The 2022 IEEE Holm Conference will include excellent papers. These papers are authored by outstanding contributors in this field from USA, China, Germany, Japan, France, United Kingdom, and Norway. These papers will provide the attendees with up-to-date information on a wide range of subjects that makes this conference so attractive to the practicing engineer.

## Background

The Holm Conference began in 1953 as a forum for the discussion of electrical contact phenomena and related fields. In 1968, the conference was named the Holm Seminar in honor of Dr. Ragnar Holm, whose contributions to the field of electrical contacts spanned 50 years and forms the foundation of the electrical contacts field, was the inspiration and guide of the Conference from its inception until his death in 1970.

In addition to the Annual Conference, the Conference Organization regularly conducts an intensive course on contacts and participates in the biannual International Conference on Electrical Contacts.

## Registration

All participants are encouraged to pre-register to avoid lines at conference and to obtain the discounted fee.

### CONFERENCE REGISTRATION

	On/Before August 15	After August 15
IEEE Member	US\$800	US\$875
Non- Member	US\$875	US\$950
Student/Life Member	US\$350	US\$400

### CONFERENCE REGISTRATION HOURS

Sunday 23 October	4:00PM – 6:00PM
Monday 24 October	7:00AM – 5:00PM
Tuesday 25 October	7:30AM – 5:00PM
Wednesday 26 October	8:00AM – 12:00PM

Registration can be completed online:

<https://ieee-holm.org/registration/>

### Registration payments:

Checks are to be made out to the IEEE HOLM in US\$. Visa, MasterCard, Discover, and American Express are accepted.

For additional information please contact Holm Registrar, at:

US and Canada: +1 800 810 4333  
Elsewhere: +1 732 465 7810  
Email: holmreg@ieee.org

## Event Location and Rooms

### WELCOME RECEPTION

All conference attendees are invited to register early and to attend our welcome reception on Sunday, 23 October from 4:00 PM – 6:00 PM at the Westin Tampa Waterside. The hotel is located on Harbour Island near the scenic Tampa Riverwalk.

## Hotel Accommodations

The 2022 Conference meets in Tampa, Florida at the **Westin Tampa Waterside**, which has meeting facilities well suited to the conference sessions and other activities. The hotel is offering special rates of US\$189 single/double occupancy to conference attendees. Rates are subject to state and local tax. To make a reservation please use the Holm Conference link at <https://iee-holm.org/venue/> or call +1 (813) 229 5000

or call Westin Tampa Waterside at 1-813-229-5000, and please refer to the group name as “2022 Holm Conference” in order to receive the group rate. The rate is valid until October 1<sup>st</sup>, **2022** at 5:00PM EST. Reservations received after this date will be subject to space and availability. Cancellation policies may vary depending on the rate and dates of your reservation. Please refer to your reservation confirmation to verify your cancellation policy. If you need further assistance, call the hotel directly or contact customer service.

Check in time: 3:00PM CST  
Check out time: 11:00PM CST

Westin Tampa Waterside  
725 S. Harbour Island Blvd.  
Tampa, FL 33602  
+1 (813) 229 5000

## Transportation

### Airport and Driving Directions:

#### **FROM TAMPA INTERNATIONAL AIRPORT – 17 MINUTES/9.9 MILES**

Get on I-275 N/Tampa. Take I-275 N to N Tampa St. Continue on I-275 to Exit 44. Take Exit 44 and continue on N. Tampa St. Destination will be on the right at 725 S. Harbour Island Blvd.

For specific driving directions consult:

<http://www.ieee-holm.org/venue.html>

or call the hotel directly at +1 (813) 229-5000.

## Conference Banquet

### The Columbia Cafe

24 October 2022

6:30PM



Photo Credit – The Columbia

The IEEE Holm Banquet will be held in the Columbia Café located at the Tampa Bay History Center, just a short walk from the conference venue. The address is 801 Water St., Tampa, FL. The site offers Waterfront dining on the Tampa Riverwalk in the new Water Street neighborhood.

As Florida's oldest restaurant, the Columbia restaurant group has seven locations in Florida and is still owned and operated by descendants of its founder, Spanish-Cuban immigrant Casimiro Hernandez, Sr. After arriving in Tampa, FL, with his four young sons, searching for opportunity and a better life, he helped open the Columbia Saloon on Dec. 17, 1903. Casimiro's descendants have diligently cared for the Columbia Restaurant and helped preserve his American dream. Over nearly 120 years, the original restaurant has expanded to an entire city block and is now the largest Spanish restaurant in the world.

The location of our event is the Columbia Café, which is one of 6 locations in the Tampa area, that carry on the traditions started by Casimiro Hernandez, Sr.

Each conference attendee will receive a ticket to attend the Banquet. Additional tickets may be purchased for the rate of \$80 USD.

## **Holm Conference Ragnar Holm Scientific Achievement Award**

The Ragnar Holm Scientific Achievement Award derives its significance and prestige from the scientist whose name it carries. The contributions of Dr. Ragnar Holm to electrical contact theory and application are renowned the world over. The award, created in 1971 by the Steering Committee of the Holm Conference, honors the memory of the founder of modern electrical contact science by recognizing outstanding scientists and engineers in the field of electrical contacts or related technologies.

### **2022 RAGNAR HOLM SCIENTIFIC ACHIEVEMENT AWARDEE**

#### **XINGWEN LI**



Xingwen Li (Senior Member, IEEE) was born in Shaanxi, China, in 1978. He received the B.S., M.S., and Ph.D. degrees in electrical engineering from Xi'an Jiaotong University, Xi'an, China, in 1999, 2001, and 2006, respectively. He was a Visiting Scholar at the Department of Information Systems, Osaka University, Japan, from 2001 to 2002. Currently, he is a Professor at Xi'an Jiaotong University.

Prof. Xingwen Li has made significant contributions to arc behavior analysis and design optimization of low and high voltage switchgears, DC circuit breaker and DC arc fault safety for PV systems, and pulsed plasma interaction with materials for energy applications.

Prof. Li has authored 127 peer-reviewed papers in international journals and has also 27 papers presented at the IEEE Holm Conference and the International Conference on Electrical Contacts (ICEC) which he has been attending since 2004. He has also served as the Chinese representative in the international advisory group of ICEC since 2021.

Prof. Li is the first author of two books. One is entitled "Modeling and Simulation Technology for Low Voltage Circuit Breaker", which has been widely used by Chinese engineers in their design and optimization of low circuit breakers. The second book, entitled "Discharge Plasma Technology and Application," is a textbook used in many Chinese universities.

Besides this high-level academic research, Prof. Li has more than 40 patents which prove his interest in practical work. In addition, he has extensive collaborations with Chinese industries as well as international companies including Eaton Corporation, Schneider Electric, Fuji Electric and others.



# Holm Conference Ragnar Holm Scientific Achievement Award Nomination Guidelines

**History:** The Ragnar Holm Scientific Achievement Award was created by the 1971 Holm Conference Steering Committee in honor of the memory of Dr. Ragnar Holm, the founder of the modern science of electrical contacts. This award is to be granted to the living scientist or engineer who has made significant contributions to the theory or practice of electrical contacts, or for work in related technologies which is directly applicable to contacts. In considering a person's work and selecting a recipient preference will be given for: a.) Nominees that have made contributions to the technology over many years, b.) the originality and scientific importance of contributions, and c.) achievements that have found a high degree of practice. Provided worthy candidates are found, the Award will be granted annually.

**Eligibility:** Any person may be nominated for this award regardless of IEEE membership. Members of IEEE Holm Awards Committee are not eligible to be considered for the award while serving on this committee. Nominations are not accepted for persons deceased. Candidates must have made contributions to the electrical contact field for a period spanning at least ten years.

**Nominator Eligibility:** Any person may nominate a candidate for this award, with the following exception: members of the award committee.

## Nomination Support Materials

**Endorsers:** At least two letters of endorsement are required. One is from the nominator and the others are from the endorsers selected by the nominator. Endorsers should be in a position to substantiate the candidate's contributions by providing explicit detail from personal knowledge. The nominator is responsible for submission of the letters of endorsement.

**Candidate Personal Data/Education/Work:** "Name", provide complete name of candidate, not initials. "Personal", provide date of birth, and citizenship. "Education", list year and exact degree of institute. "Society Membership", list various professional society affiliations. Under society activities list officers and major committee work. "Professional History", list present occupation followed by previous career experiences. Indicate positions held, years, and briefly explain each responsibility.

**Technical Accomplishments:** "Technical Publications", such as books, papers, reports, and standards are to be listed in chronological order giving author's names, title,

book, journal, or proceedings. "Patents", should be listed by date, number, title, and country of origin. Documentation authentication "Development of Products or processes", may be listed for items not covered by patents. "Technical Presentations", such as keynote addresses or courses developed by the candidate should also be listed.

**Significant Contributions:** Describe the candidate's outstanding contributions in terms of specific items. Provide a short paragraph to each one including a general description of the item, the degree of originality and creativity, and importance of the work to the electrical contact field and the time period over which the contribution was made. Also, state cases of examples of practices which were developed or modified through contributions of the candidate.

**Forward Nominations To:** IEEE Holm Award Committee, c/o IEEE Holm Conference Planner, 445 Hoes Lane, Piscataway, NJ 08854 USA

**2022 Nominations Deadline:** 1 February 2023

## Morton Antler Lecture

The Morton Antler Lecture is an annual technical presentation given at the IEEE Holm Conference on a topic of special interest to the electrical contact community. The lecture series was established in honor of Dr. Morton Antler, a longtime member of the Holm Steering Committee and participant in the Holm Conference. Dr. Antler was a distinguished scientist and lecturer in the fields of electrical contacts, tribology, corrosion, and electrodeposition.

## Sponsors of 67<sup>th</sup> IEEE Holm Conference on Electrical Contacts

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# Technical Program

MONDAY, 24 OCTOBER 2021

8:00AM – 8:10AM

## INTRODUCTION AND OPENING REMARKS

GEORGE FLOWERS, 2022 IEEE Holm Conference Chair

8:10AM – 9:50AM

## YOUNG INVESTIGATOR SESSION

CHAIR: DAVID WILLIAMS

CO-CHAIR: GUANG YANG

### 1.1 Fretting and Electrical Contact Resistance

#### Characteristics of Carbon Nanoparticle-coated Cu Electrical Contacts

*Bruno Alderete<sup>1</sup>, Diana Bucio Tejeda<sup>2</sup>, Sebastian Suarez<sup>1</sup>, Frank Mcklich<sup>1</sup>*

*<sup>1</sup>Saarland University, <sup>2</sup>National Autonomous University of Mexico*

### 1.2 The Analysis of Failure Mechanisms of Electrical Connectors in Long-term Use Field Vehicles

*Dirk Hilmert<sup>1</sup>, Haomiao Yuan<sup>1</sup>, Jian Song<sup>2</sup>*

*<sup>1</sup>OWL University of Applied Sciences and Arts, <sup>2</sup>Ostwestfalen-Lippe University*

### 1.3 Methodical Approach for Tribo-electrical and Topographical Tailoring of Cu-Sn Connectors with Extended Direct Laser Interference Patterning

*Adrian Thome<sup>1</sup>, Christian Schaefer<sup>1</sup>, Fabian Bonner<sup>1</sup>, Adrian Herges<sup>1</sup>, Silas Daniel Schuetz<sup>1</sup>, Dominik Britz<sup>2</sup>,; Frank Muecklich<sup>3</sup>, and Sebastian Suarez<sup>4</sup>,*

*<sup>1</sup>Material Engineering Center Saarland (MECS), <sup>2</sup>SurFunction, <sup>3</sup>Chair of Functional Materials, Saarland University, <sup>4</sup>Dept. of Materials Science and Engineering, Saarland*

### 1.4 A Comprehensive Study on the Contact Materials of an MVDC Hybrid Circuit Interrupter Based on the Piezoelectric Actuator

*Alfonso Cruz<sup>1</sup>, Zhiyang Jin<sup>1</sup>, Tushar Damle<sup>2</sup>, Maryam Tousi<sup>1</sup>, Nickolas A. Lee<sup>1</sup>, and Lukas Graber<sup>1</sup>*

*<sup>1</sup>Georgia Institute of Technology, <sup>2</sup>S&C company*

### 1.5 Influence of the Degree of Freedom in Normative Test Conditions on the Short-Circuit Behavior of Power Plug-In Connectors

*Michelle Pomsel<sup>1</sup>, Toni Israel<sup>1</sup>, Christian Hildmann<sup>1</sup>, Stephan Schlegel<sup>1</sup>, and Tom Kufner<sup>2</sup>*

*<sup>1</sup>TU Dresden, <sup>2</sup>Stubli Electrical Connectors AG*

9:50AM – 10:05 AM BREAK

10:05AM – 11:05AM

## HOLM AWARD

CHAIR: JERRY WITTER

### 0.1 Gaseous Switching Arc and Extension to Pulsed Plasma

**11:05AM – 11:20AM BREAK**

**11:20AM – 12:20AM**

**MODELING**

CHAIR: GEORGE FLOWERS

CO-CHAIR: ROBERT JACKSON

**2.1 Impact of Layer Thickness on Contact Resistance of Multi-Spot Contacts**

*Robert Malucci*

*RD Malucci Consulting*

**2.2 Mathematical Models of the Vapor, Liquid and Solid States of the Arc Erosion in Electrical Contacts**

*Stanislav Kharin (Professor)*

**2.3 Motion Analysis of a Multi-DOF Contact of Vacuum Relay Based on Dynamics Model and Its Load Experiment**

*Zhuoran Li<sup>1</sup>, Jiaxin You<sup>1</sup>, Shan Jiang<sup>1</sup>, Enyao Qin<sup>2</sup>  
Bingbing Jia<sup>2</sup>, and Yongjian Zhang<sup>1</sup>*

*<sup>1</sup>Harbin Institute of Technology, <sup>2</sup>Kunshan GuoLi  
Electronic Technology Co., Ltd*

**12:20PM – 1:40PM LUNCH (ON YOUR OWN)**

**YOUNG INVESTIGATOR POSTER SESSION (CLOSED TO JUDGES ONLY, LOCATION TO BE DECIDED)**

**1:40PM – 2:40PM**

**VACUUM INTERRUPTERS**

CHAIR: ROBERT JACKSON

CO-CHAIR: TIMO MÜTZEL

**3.1 Impact of Ramp Rate of Electric and Magnetic field on Magnetron Pressure Measurements of Vacuum Interrupters**

*Tushar Damle, Gabrielle Madden, Raphael Guio, and  
Kip Benson*

*S&C Electric Company;*

**3.2 Simulation and Measurement of the Magnetic Field Signature of a Vacuum Circuit Breaker and the Identification of Arcing**

*Ning Guo, Kevin Whitmore, Morris Cohen, Tohid  
Shekari, Raheem Beyah, and Lukas Graber*

*Georgia Institute of Technology*

**3.3 Criteria for the Application of Vacuum Interrupters in HVDC Circuit Breakers**

*Paul Slade*

*Consultant*

**2:40PM – 2:55PM BREAK**

**2:55PM – 3:55PM**

**ARC DETECTION**

CHAIR: JOHN MCBRIDE

CO-CHAIR: DIEGO GONZALEZ

**4.1 DC Series Arc Fault Detection Method Using Convolution Neural Network**

*Patrick Schweitzer<sup>1</sup>, Ruobo Chu<sup>2</sup>, Yueyang Jiang<sup>3</sup>, Christophe Bonnet<sup>3</sup>, Yves Berviller<sup>3</sup>, Serge Weber<sup>3</sup>, Etienne Tisserand<sup>3</sup>, and Alexis Chabert<sup>4</sup>*

*<sup>1</sup>Univ Lorraine IJL - CNRS, <sup>2</sup>Huaqiao University,*

*<sup>3</sup>University of Lorraine, <sup>4</sup>IRT Toulouse*

**4.2 Hardware Implementation of Time-Frequency Analysis Based DC Arc Fault Detection Algorithm in Photovoltaic Systems with Different Power Electronic Equipment**

*Yu Meng<sup>1</sup>, Silei Chen<sup>2</sup>, Hongwei Zhou<sup>3</sup>, Jie Luo<sup>3</sup>, and Xingwen Li<sup>1</sup>*

*<sup>1</sup>Xi'an Jiaotong University, <sup>2</sup>Xi'an University of Technology, <sup>3</sup>TBEA Xi'an Electric Technology Co., Ltd.*

**4.3 The Influence of Time-Frequency Transforms on AC and DC Arc Fault Signal Representation**

*Silei Chen<sup>1</sup>, Yuanfeng Wang<sup>1</sup>, Yu Meng<sup>2</sup>, Xingwen Li<sup>2</sup>, and Shiwei Ge<sup>3</sup>*

*<sup>1</sup>Xi'an University of Technology, <sup>2</sup>Xi'an Jiaotong University, <sup>3</sup>Zhejiang Tengen Electric Co. Ltd.*

**4:10PM – 5:10PM**

**SURFACE EFFICACY**

CHAIR: SOPHIE NOEL

CO-CHAIR: ROBERT JACKSON

**5.1 Influence of the Electrode Geometry at the Microstructure in Copper Braid Assemblies Resistance Spot Welding**

*Mariana Carrillo-Aguilar, Pedro Alvarez-Vazquez, Edmundo Diaz-Esparza-Zarate, and Roberto Hernandez-Maya*

*Siemens*

**5.2 Effects of Insulation Residues on the Contacting Process of Copper Flat Wire Connections**

*Alexander Kuehl*

*Friedrich-Alexander-Universität Erlangen-Nürnberg*

**5.3 Friedrich-Alexander-Universität Erlangen-Nürnberg Influence of Enameled Wire Preparation on the Laser Welding of Hairpin Windings**

*Tobias Glaessel, Andreas Riedel, and Alexander Kuehl*

*Friedrich-Alexander-Universität Erlangen-Nürnberg*

**6:00PM CONFERENCE BANQUET – THE COLUMBIA CAFÉ**

8:00AM – 9:00AM

**LUBRICATION AND CORROSION PREVENTION**

CHAIR: GEORGE FLOWERS

CO-CHAIR: ROD MARTENS

**6.1 A Mixed-Lubrication Model of an Electrical Contact During Vibration**

*Robert L. Jackson<sup>1</sup> and Santosh Angadi<sup>2</sup>*

*<sup>1</sup>Auburn University, <sup>2</sup>Nitte Meenakshi Institute of Technology*

**6.2 Lubricated Tin-Nickel: A Reliable Contact Interface for High-Speed Ground Connections**

*Rod Martens, Suvrat Bhargava, John Consoli, Chad Morgan, Daniel Hubbard, Matt Little, and Tim Minnick*  
*TE Connectivity*

**6.3 Innovative Sol-Gel Coatings for Corrosion Protection of Connector Housings**

*Julien Acquadro<sup>1</sup>, Sophie Noel<sup>1</sup>, Pascal Chrétien<sup>1</sup>, Frédéric Houzé<sup>1</sup>, Philippe Testé<sup>1</sup>, Clément Genet<sup>3</sup>, Hiba Azougaghe<sup>2</sup>, Florence Ansart<sup>2</sup>, Marie Gressier<sup>2</sup>, Marie Joelle Menu<sup>2</sup>, Robin Montpellier<sup>3</sup>, Olivier Gavard<sup>3</sup>, Romain Leroy<sup>4</sup>, Gérald Trédan<sup>4</sup>, Simon Demarthon<sup>5</sup>, Thomas Pichot<sup>5</sup>, Muriel Ladiré<sup>6</sup>, and Frederic Raoul<sup>6</sup>*

*<sup>1</sup>Université Paris-Saclay, <sup>2</sup>Université Toulouse*

*<sup>3</sup>Amphenol Socapex, <sup>4</sup>Radiall, <sup>5</sup>Souriau ITD EATON*

*<sup>6</sup>TE Connectivity*

9:00AM – 9:15AM BREAK

9:15AM – 10:15AM

**MORTON ANTLER LECTURE**

CHAIR: GERALD WITTER

10:15AM – 10:30AM BREAK

10:30AM – 11:50AM

**NANO AND MICRO SCALE SYSTEMS**

CHAIR: JOHN MCBRIDE

CO-CHAIR: SOPHIE NOEL

**7.1 Microcontact Support Structure Fabrication to Study Microswitches Reliability and Performance Using a Novel Test Fixture**

*Protap Mahanta, Turja Nandy, and Ronald Coutu*  
*Marquette University*

**7.2 The Effective Resistivity of Dissimilar Contact Materials Using an Automated MEMS Switching Test Platform**

*Thomas Bull<sup>1</sup>, John McBride<sup>1</sup>, Ronald Coutu<sup>2</sup>, Hong Liu<sup>3</sup>, and Yan Yang<sup>4</sup>*

*<sup>1</sup>University of Southampton, <sup>2</sup>Marquette University,*

*<sup>3</sup>Jiangsu University, <sup>4</sup>Taicaan Technologies*

**7.3 Load-Dependent Electrical Contact Resistance of Carbon Nanotube-Reinforced Metal Matrix Composites**

*Sebastian Suarez<sup>1</sup>, Rafael Puyol<sup>2</sup>, Bruno Alderete<sup>1</sup>, and Frank Mcklich<sup>3</sup>*

<sup>1</sup>Dept. of Materials Science and Engineering, Saarland University, <sup>2</sup>ICTEAM, Universit Catholique de Louvain, Belgium, <sup>3</sup>Chair of Functional Materials, Saarland University

#### **7.4 Influence of Core/Shell Nanoparticles on the Fretting Behavior of Electrical Contacts**

*Haomiao Yuan, Roman Probst, and Jian Song  
Ostwestfalen-Lippe University*

### **12:00 Noon – 1:30PM AWARDS LUNCHEON**

**1:30PM – 2:50PM**

#### **RELAYS AND CONTACTORS**

CHAIR: DIEGO GONZALEZ

CO-CHAIR: TUSHAR DAMLE

#### **8.1 Setup of a High Power DC Test Laboratory for Voltages up to 12 kV and Currents up to 30 kA to Research the Performance of Future Medium Voltage Components.**

*Frederik Anspach, Dirk Boesche, Patrick Vieth, Tobias Kopp, Soeren Meyer, Ernst-Dieter Wilkening, and Michael Kurrat*

*TU Braunschweig Elenia Institute of High Voltage and Powersystems*

#### **8.2 Robust Design of Dynamic Characteristics Consistency of BMEC Based on a Fast Calculation Surrogate Model**

*Yufei Qiao<sup>1</sup>, Guofu Zhai<sup>1</sup>, Ding Ding<sup>1</sup>, Xinshuai Du<sup>1</sup>  
Haiyan Zhang<sup>1</sup>, and Chenglong Zhou<sup>2</sup>*

*<sup>1</sup>Harbin Institute of Technology, <sup>2</sup>ShaanXi QunLi Electric Co., Ltd.*

#### **8.3 Investigation on Switching Capability of Bridge Structures Within Power Electromagnetic Relays**

*Yinnan Zhang<sup>1</sup>, Yuanfeng Zhang<sup>2</sup>, Zhe Zheng<sup>1</sup>, and Wanbin Ren<sup>1</sup>*

*<sup>1</sup>Harbin Institute of Technology, <sup>2</sup>Naval Aviation University, Qingdao Campus*

#### **8.4 Experimental Research on the Switching Characteristics of On-Load Tap Changers**

*Chunen Yang<sup>1</sup>, Zhihao Gu<sup>1</sup>, Chao Zhang<sup>1</sup>, Xian Yang<sup>2</sup>,  
Danyu Jiang<sup>2</sup>, and Wanbin Ren<sup>1</sup>*

*<sup>1</sup>Harbin Institute of Technology, <sup>2</sup>Electric Power Research Institute of Guangdong Power Grid Corporation*

### **2:50PM – 3:05PM BREAK**

**3:05PM – 4:25PM**

#### **SWITCHES AND BREAKERS**

CHAIR: PETER HALE

CO-CHAIR: DAVID WILLIAMS

#### **9.1 A Piezoelectric Actuator Optimized for Fast Mechanical Switch Applications**

*Maryam Tousi<sup>1</sup>, Guillaume Mansuy<sup>2</sup>, Mathieu Thomachot<sup>2</sup>, Alexandre Pages<sup>2</sup>, Ebrahim Karimi<sup>1</sup>,*

Zhiyang Jin<sup>1</sup>, Kevin Whitmore<sup>1</sup>, and Lukas Graber<sup>1</sup>

<sup>1</sup>Georgia Institute of Technology, <sup>2</sup>Cedrat Technologies

**9.2 Investigation of the Plasma of a DC-Hybrid Model Switch at Beginning of Contact of Separation**

Diego Gonzalez<sup>1</sup>, Ralf Methling<sup>1</sup>, Sergey Gortschakow<sup>1</sup>, Hendrik Koepf<sup>2</sup>, Stefan Holbe<sup>2</sup>, and Peter Steegmueller<sup>2</sup>

<sup>1</sup>Leibniz Institute for Plasma Science and Technology, <sup>2</sup>E-T-A GmbH

**9.3 Effect of Gassing Material on Partial Discharges Characteristics in MCCB**

Zijie Liao<sup>1</sup>, Qian Wang<sup>2</sup>, and Xingwen Li<sup>1</sup>

<sup>1</sup>Xi'an Jiaotong University, <sup>2</sup>Xi'an University of Technology

**9.4 Optimization Design of Interruption Characteristics of LVDC Hybrid Circuit Breaker**

Zhaozi Zhang<sup>1</sup>, Caizhi Gao<sup>1</sup>, Qian Wang<sup>2</sup>, Silei Chen<sup>2</sup>, Zhongzheng Xue<sup>1</sup>, and Xingwen Li<sup>1</sup>

<sup>1</sup>Xi'an Jiaotong University, <sup>2</sup>Xi'an University of Technology

**4:30M – 5:30PM TC1 MEETING**

CHAIR: GERALD WITTER



8:00AM – 9:00AM

**SURFACE WEAR AND DESIGN**

CHAIR: ROD MARTENS

CO-CHAIR: PETER HALE

**10.1 Quantification of Pin Fretting in the PCB Connectors Subjected to Random Vibration Excitation**

*Sushil Doranga<sup>1</sup>*

*<sup>1</sup>Lamar University*

**10.2 Tribopolymer Formation via OMTS in Sliding Electrical Contacts**

*Nicolas Argibay<sup>1</sup>, Donald F. Susan<sup>2</sup>, John Curry<sup>2</sup>, and Michael Dugger<sup>2</sup>*

*<sup>1</sup>Ames Lab, <sup>2</sup>Sandia National Laboratories*

**10.3 Generation of Asymmetric Topographic Structures in Cu-Sn Connectors Using Extended Direct Laser Interference Patterning for the Tailoring of Insertion and Removal Forces.**

*Silas Schtz<sup>1</sup>, Sebastian Suarez<sup>2</sup>, Dominik Britz<sup>3</sup>, and Frank Mcklich<sup>1</sup>*

*<sup>1</sup>Chair of Functional Materials, Saarland University,*

*<sup>2</sup>Dept. of Materials Science and Engineering, Saarland University, <sup>3</sup>SurFunction GmbH*

9:00AM – 9:15AM BREAK

9:15AM – 10:35AM

**THERMO-ELECTRIC MODELING**

CHAIR: ROBERT JACKSON

CO-CHAIR: Z. K. CHEN

**11.1 Thermal Analysis of Electric Fuse using Finite Element Method**

*Ying Sun and Todd Dietsch*

*Littelfuse*

**11.2 Aluminum 5052 as Alternative Material for Electro-Thermal Applications**

*Brenda Trevino, Roberto C. Hernandez, and Ismael F. Morales*

*Siemens*

**11.3 Modeling and Analysis of Electrical-Thermal Performance of the Contact Surface of Coaxial Connectors at High Frequency and High Power**

*Yuqi Zhou<sup>1</sup>, Jinchun Gao<sup>1</sup>, and George Flowers<sup>2</sup>*

*<sup>1</sup>Beijing University of Posts and Telecommunications,*

*<sup>2</sup>Auburn University*

**11.4 A Steady-State Thermal Network Analysis Modeling Method for Hermetically Sealed Electromagnetic Relay and Its Experimental Verification**

*Huimin Liang<sup>1</sup>, Bo Li<sup>2</sup>, Shan Jiang<sup>1</sup>, Yupeng Chai<sup>1</sup>, Lingzhi Wang<sup>3</sup>, and Jieshu Wang<sup>4</sup>*

*<sup>1</sup>Harbin Institute of Technology, Xiamen Hongfa*

*Electroacoustic Co, <sup>4</sup>Changchun University of Technology*

**10:35AM –10:50AM BREAK**

**10:50AM – 12:10PM**

**CONNECTORS AND SYSTEM PERFORMANCE**

CHAIR: DEEPAK PATIL

CO-CHAIR: ROD MARTENS

**12.1 State of Health of Connectors – Early Indicators**

*Jian Song<sup>1</sup>, Abhay Shukla<sup>2</sup>, Roman Probst<sup>2</sup>*

*<sup>1</sup>Ostwestfalen-Lippe University, <sup>2</sup>OWL University of Applied Sciences & Arts*

**12.2 Effects of Mechanical Design on Passive Intermodulation in Coaxial Connectors**

*Junyu Luo<sup>1</sup>, George Flowers<sup>2</sup>, Jinchun Gao<sup>1</sup>, and Lingyu Bi<sup>1</sup>*

*<sup>1</sup>Beijing University of Posts and Telecommunications, <sup>2</sup>Auburn University*

**12.3 Dynamic Variation Characteristics of Glowing Contact Resistance**

*Jing Zhang, Tao Chen, Guofeng Su, Changzheng Li, and Wenzhong Mi*  
*Tsinghua University*

**12.4 The Influence of Line Impedance on Leakage Current Detection in Low Voltage DC Systems**

*Zhongzheng Xue<sup>1</sup>, Silei Chen<sup>2</sup>, Jing Wang<sup>3</sup>, Xingwen Li<sup>1</sup>, and Shiwei Ge<sup>4</sup>*

*<sup>1</sup>Xi'an Jiaotong University, <sup>2</sup>Xian University of Technology, <sup>3</sup>Shenzhen Power Supply Bureau Co., Ltd., <sup>4</sup>Zhejiang Tengen Electric Co. Ltd.*

**12:10PM**

**CLOSING REMARKS**

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