Final Program

62nd IEEE Holm Conference on Electrical Contacts

9-12 October 2016
Hilton Hotel
Clearwater Beach, FL
USA

Sponsored By:
The Components, Packaging, and Manufacturing Technology Society of The Institute of Electrical and Electronics Engineers, Inc.
2016 HOLM Conference Officers

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Paul Slade, CONSULTANT

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- Brett Rickett, Immediate Past Conference Chairman

# 2016 Awards Committee

- Sophie Noel
- John McBride
- Roland Timsit

# 2016 Prize Paper Award Committee

- Peter Hale
- Robert Jackson
- David Williams
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 2016 IEEE Holm Conference will include excellent papers authored by outstanding technical people in this field. The international contributors come from Australia, China, France, Germany, Japan, Kazakhstan, Mexico, Norway, Sweden, Switzerland, the United Kingdom, and the USA. 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.

Additionally, the 2016 IEEE Holm Conference will make it possible for any attendee to discuss personally, with any author, either additional details concerning the work presented by the author at the conference or any subject related to the author’s field of expertise.

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

CONFERENCE REGISTRATION

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INTENSIVE COURSE REGISTRATION

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CONFERENCE & INTENSIVE COURSE REGISTRATION

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CONFERENCE REGISTRATION HOURS

- Sunday 9 October: 4:00PM – 6:00PM
- Monday 10 October: 7:00AM – 5:00PM
- Tuesday 11 October: 8:00AM – 4:30PM
- Wednesday 12 October: 8:00AM – 4:00PM

Registration can be completed online:

http://www.cvent.com/events/the-62nd-ieee-holm-conference-on-electrical-contacts/event-summary-ba77b248ca5c49c897649a7d0c814f29.aspx

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

WELCOME RECEPTION

All conference attendees are invited to register early and to attend our welcome reception on Sunday, 9 October from 4:00 PM – 6:00 PM at the Sandpiper Deck, Hilton Clearwater Beach Hotel.
62nd IEEE Holm Conference on Electrical Contacts

The 2016 conference meets in Clearwater Beach, Florida at the Hilton Hotel, where meeting facilities are well suited to the conference sessions and other activities. The hotel is offering special rates of US$169* single/double occupancy to conference attendees. Rates are subject to a daily US$ 10 resort charge plus state and local tax. To make a reservation please use the Holm Conference link http://www.hilton.com/en/hi/groups/personalized/P/PIECBHF-IEEE-20161001/index.jhtml?WT.mc_id=POG or call the Hilton Clearwater Hotel Reservations 1-800-753-3954, and please refer to the group name as “IEEE” in order to receive the group rate. The rate is valid until September 4th 2016 at 5:00PM EST. Reservations received after this date will be subject to space and availability. Attendees will be charged 1 night’s deposit at time of booking, which is refundable in case of a cancellation as long as you cancel your room before 6pm, 3 days prior to arrival.

Check in time: 3:00PM EST
Check out time: 12:00PM EST

Hilton Hotel
400 Mandalay Ave
Clearwater Beach, Florida
33767 USA
+1 (727) 461-3222

Airport and Driving Directions: http://www.omnihotels.com/hotels/san-diego/property-details/directions

FROM TAMPA INTERNATIONAL AIRPORT – 25 MINUTES/20 MILES
From Tampa International Airport, take SR-60 W towards Clearwater. Continue on SR-60 W across Courtney Campbell Causeway, through Clearwater and then crossover the Memorial Causeway to Clearwater Beach. At roundabout take the 2nd exit on your right onto Mandalay Ave. The Hilton Clearwater Beach is on the left.

DIRECTIONS FROM St. Petersburg / Clearwater International Airport
Take CR-611 over the Bayside Bridge. Take SR-60 W towards Clearwater. Continue on SR-60 W across the Memorial Causeway to Clearwater Beach. At roundabout take the 2nd exit on your right onto Mandalay Ave. The Hilton Clearwater Beach is on the left.
DIRECTIONS FROM ORLANDO
From Orlando, take I-4 W towards Tampa for approximately 60 miles. Then, take I-275S towards Tampa International Airport / St. Petersburg. Merge onto SR-60 W towards Clearwater. Continue on SR-60 W across Courtney Campbell Causeway, through Clearwater and then crossover the Memorial Causeway to Clearwater Beach. At roundabout take the 2nd exit on your right onto Mandalay Ave. The Hilton Clearwater Beach is on the left.

Tampa International Airport:
- Taxi: Approximately $50 one way
- Shuttle: Approximately $25 one way per person
- Limo: Approximately $65 one way

DRIVING:
If you are arriving by your own transportation, parking fees at the Hilton Clearwater Beach Hotel are as follows:

Self Parking: $18 USD per car/day

Valet Parking: $22 USD per car/day

For specific driving directions from Tampa International Airport, consult Map Quest at www.mapquest.com or call the hotel directly at +1 (727) 461-3222.
Ready for a dazzling dinner and night out? StarLite offers great dining, live entertainment and dancing with some of the best waterfront views in all of Clearwater Beach from brilliant vistas to starlit evenings, every StarLite cruise is special. Dining service includes a full, restaurant-style menu featuring continental cuisine prepared fresh on board. Entertainment is a mix of live selections and a wide variety of recorded songs to satisfy any musical request. Full bar and your own server ensure your enjoyment.

The StarLite Majesty Dining Yacht is located at the Clearwater Beach Marina, - Slip #152 25 Causeway Blvd. Clearwater, FL 33767

Each conference attendee will receive a ticket to attend the social event on the Majesty Yacht. Additional tickets may be purchased for the rate of $80 USD.
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 Nominations Committee, c/o IEEE Holm Conference Planner, 445 Hoes Lane, Piscataway, NJ 08854 USA

**2017 Nominations Deadline:** 13 January 2017
The 63rd IEEE Holm Conference on Electrical Contacts (2017)

The 63rd IEEE Holm Conference on Electrical Contacts will be held September 10-13, 2017, in Denver, Colorado, USA.

Prospective authors should submit a brief abstract (200 words maximum) online before February 3, 2017. Authors will be notified concerning acceptance of abstracts by February 17, 2017.

Please include complete contact information for all correspondence to be sent.

Abstracts are to be submitted through the IEEE Conference eXpress website: http://www.ieee.org/conferencepublishing
Enter conference ID – holm17 (please use lower case)

Important Dates

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<tr>
<td>February 3, 2017</td>
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<tr>
<td>February 17, 2017</td>
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<tr>
<td>April 21, 2017</td>
<td>Completed Paper Deadline</td>
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<td>September 10, 2017</td>
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Correspondence Address

IEEE Meeting & Conference Management
IEEE Holm Conference (2016)
445 Hoes Lane
Piscataway, NJ 08854
US and Canada: +1 800 810 4333
Elsewhere: +1 732 465 7810
Fax: +1 732 465 6447
Email: holmreg@ieee.org

Holm Website:
http://www.ieee-holm.org
The Morton Antler Lecture is an annual technical presentation given at the IEEE Holm Conference on a topic of interest to the electrical contact community. Our committee tries to pick subjects covering contemporary technical advancements. 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.

50 Years of the Holm Conference on Electrical Contacts
1967 – 2016

Dr. Paul Slade
Consultant, Circuit Interruption and Electrical Contacts

Abstract:

I am greatly honored to have been asked to give the Mort Antler lecture especially as I had the privilege of knowing Mort as an active colleague for many years. He made many valuable contributions to our understanding of failure mechanisms in electronic connectors. Indeed his research and published papers are still widely referenced today.

I have personally attended all 50 Holm Conferences from 1967 to 2016 where more than 2100 papers have been presented and published covering all aspects of electrical contact science and technology. It has proved an impossible task to condense all this knowledge into this short lecture. Therefore, the focus of my lecture will be to offer my own perspective and observations of the advances in contact science and engineering that have taken place during these 50 years. My lecture will begin with an overview of the Conference’s evolution from the Holm Seminars to the present IEEE Holm Conference on Electrical Contacts. It will then explore how new technology has affected all aspects of contact researchers’ lives.

My lecture will track the developments in fixed connector research and the knowledge that has been gained from it. While measurements of contact resistance and contact voltage have been and remain the most common diagnostic tools, instrumentation developed since the early 1960’s has
enhanced the ability to analyze changes in contact surfaces. The most important of these has been the scanning electron microscope (SEM) with EDS, energy dispersive spectroscopy and XPS, X-ray photoelectron spectroscopy.

It is apparent that over time the variations in metals pricing and changes in environmental law have been a driving force leading contact research into a new understanding of corrosion, fretting, lubrication, intermetallic compounds and whisker formation. For example, the gradual increase in the price of gold and silver after 1974 saw an increase in papers discussing the pros and cons of tin plating. Another interesting observation is that a price increase for copper in the late 1960's led to its replacement by aluminum wiring in some residential construction. This in turn led to connection failures and even household fires. As a result of these events, household circuit breakers have now been developed that can detect low current arcing events. Thus a research overlap between fixed connectors and switching devices evolved.

The research activity on switching contacts shows that silver (its alloys and mixtures) continues to be the only economically viable material for relays, contactors and circuit breakers operating in air. The outlawing of cadmium has resulted in the gradual replacement of silver cadmium oxide with a variety of silver tin oxide type materials developed by intensive research efforts by multiple companies from 1970 through 2016.

The more recent use of high voltage DC switching in hybrid and electric automobiles and photovoltaic systems has triggered the development of compact relays that can interrupt voltages up to 700V DC. The use of very high magnetic field magnets transverse to the arc has shown that it is possible to interrupt these higher voltage circuits. At present there is no adequate explanation of the physical phenomenon involved. Significant work has also been done to better understand the causes of device failures from arc interactions with contact materials and air and also with ambients that contain silicones and hydrocarbons. Serious failures can now be prevented by our understanding of these reactions.

My lecture will then take an intriguing look at activation: the interaction of the arc and a hydrocarbon atmosphere. Did contact scientists miss the opportunity for great glory?? The useful “rules of thumb” that have been used these past 50 years will be restated. This will be followed by a brief overview of where future research may lead us.
The Holm Conference Prize Paper Award was established in 1970. At that time, the Conference Steering Committee recognized that at each Conference there was at least one paper that stood out from the others in its technical content and quality of presentation. Therefore, the Prize Paper Award Committee was established. The Committee’s purpose is to review each paper, listen to each presentation and then judge which paper should receive the Prize Paper Award. The award is presented to the authors of the Prize Paper at the following year’s Holm Conference.

Novel Materials Solutions and Simulations for Nanoelectromechanical Switches

Frank Streller, Graham E. Wabiszewski, Daniel B. Durham, Fan Yang, Jing Yang, Yubo Qi, David J. Srolovitz, Andrew M. Rappe, and Robert W. Carpick, University of Pennsylvania, USA.
Rod Martens (M ’96-SM’04) received his Bachelor’s (1989) and Master’s (1994) degrees from the University of Tulsa and the Ph.D. degree (1996) from the University of Maryland, all in Mechanical Engineering. In 1996, he joined the Hewlett-Packard Company in Fort Collins, Colorado as a technical contributor responsible for package and socket reliability for server products. From 2000 to 2010, he was with FormFactor, Inc. in Livermore, CA, as Senior Director, R&D performing research in MEMS based semiconductor probing. Currently, Dr. Martens is a Senior Principal Engineer with TE Connectivity in Harrisburg, PA where his research focuses on electric contact finishes.

Dr. Martens has been actively involved with the Holm Conference since 2003, serving on the prize paper, technical program, operating and steering committees and is an instructor for the IEEE Intensive Course on Electric Contacts. He will serve as general chair for the 2017 and 2018 IEEE Holm conferences.

He holds 16 US patents, been awarded one NSF grant, and has written 37 conference and journal publications in the areas of electric contacts, electronic packaging, reliability, CNT/graphene, semiconductor test, and MEMS. In 2011 Dr. Martens received the IEEE Erle Shobert Prize paper award.
Supporters of The 62\textsuperscript{nd} IEEE Holm Conference on Electrical Contacts

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Heraeus Materials Technology GmbH & Co. KG
Hindustan Platinum Pvt. Ltd.

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Whirlpool Corporation
Xi’an Jiaotong University
Xi’an University of Technology
Yazaki Parts CO., LTD
Yazaki Corporation
MONDAY, 10 OCTOBER 2016

8:00AM
INTRODUCTION AND OPENING REMARKS
Z.K. Chen, 2016 IEEE Holm Conference Chair

8:20AM– 10:00AM
YOUNG INVESTIGATOR SESSION
CHAIR: PETER HALE
CO-CHAIR: HÉLÈNE GAUTHIER

1.1 A Study of the Passive Intermodulation Induced by Nonlinear Characteristics of RF Connectors
Qiuyan Jin, Jinchun Gao, Gang Xie and Rui Ji, Beijing University of Posts and Telecommunications; George T. Flowers, Auburn University;

1.2 Stress-dependent Frequency Response of Conductive Granular Materials
Chongpu Zhai, Dorian Hanaor, Gwénaëlle Proust and Yixiang Gan, The University of Sydney

1.3 Elastic-Plastic Axisymmetric Sinusoidal Surface Asperity Contact
Swarna Saha and Robert Jackson, Auburn University

1.4 PV Series Arc Fault Recognition under Different Working Conditions with Joint Detection Method
Silei Chen and Xingwen Li, Xi’an Jiaotong University

1.5 Fretting Corrosion of Tin Coated Electrical Contacts: The Influence of Normal Force, Coating thickness and Geometry of Sample Configuration
Haomiao Yuan, Jian Song and Vitali Schinow, Ostwestfalen-Lippe University of Applied Sciences

10:00AM – 10:30PM
Break

10:30PM– 11:50PM
Arcing I
CHAIR: HENRY CZAJKOWSKI
CO-CHAIR: XIN ZHOU

2.1 Temperature Distribution in Ablation Controlled Switching Arcs using Optical Emission Spectroscopy
James Mannekutla, Romeo Bianchetti, Andreas Friberg, Thierry Delachaux and Patrick Sütterlin, ABB Corporate Research
2.2 A Hybrid DC Circuit Breaker with Vacuum Contact and SiC-MOSFET for Arcless Commutation
Koichi Yasuoka, Tsuboi Yoshiki; Tatsuya Hayakawa, Tamanosuke Oide and Nozomi Takeuchi, Tokyo Institute of Technology

2.3 Temperature Rise in a Load Break Switch
Elin Fjeld and Wilhelm Rondeel, University College of Southeast Norway, Magne Saxegaard, ABB Norway

2.4 Experimental Method to Obtain a Volumetric Representation of the Arc Splitting Process in MCCB
Juan Jose Rodriguez, Siemens Mexico

11:50PM – 13:20PM
Lunch (on your own)

13:20PM – 14:20PM
MEMS AND MICROCONTACTS I
Chair: Ronald Coutu
Co-Chair: Rod Martens

3.1 The Investigation of the Electrical Contact Resistance through Thin Oxide Layer on a Nanometer Scale
Takahiro Yudate, Jun Toyoizumi, Masanori Onuma and Takaya Kondo, Yazaki Parts CO., LTD Japan; Kikuo Mori, Yazaki Corporation; Tetsuo Shimizu, Sumiko Kawabata and Norimichi Watanabe, National Institute of Advanced Industrial Science and Technology

3.2 A Finite Element Based Electrical Resistance Study for Rough Surfaces: Applied to a Bi-layered Au/MWCNT Composite for Micro-Switching Applications
Hong Liu, University of Southampton Malaysia Campus; John W. McBride, University of Southampton

3.3 Electrical and Structural Mapping of Friction Induced Defects in Graphene Layers
Pascal Chrétien, Sophie Noël, Alexandre Jaffré, and Frédéric Houzé, CentraleSupélec, Université Paris-Saclay; David Brunel and Joanna Njeim, Université Pierre et Marie Curie-Sorbonne

14:20PM – 14:50PM
Break
14:50PM – 15:50PM
CONNECTORS I
CHAIR: Marjorie Myers
CO-CHAIR: GEORGE FLOWERS

4.1 Predicting Vibration-Induced Fretting in Land Grid Array Sockets in simulated field scenarios
Karumbu Meyyappan, QiFeng Wu, Vasu Vasudevan and Milena Vujosevic, Intel Corporation

4.2 Human Factors Affecting Bolted BusBar Reliability
David M. Williams, Consultant

4.3 Application and Comparison of Analytic Accelerated Test-models for Lifetime Prediction of a Novel Contacting Method
Michael Spahr, Sven Kreitlein, Raphael Haas, Andreas Jaumann, Tobias Glässel, Simon Spreng and Jörg Franke, Friedrich-Alexander-University

15:50PM – 16:20PM
BREAK

16:20PM – 17:20PM
MODELING
CHAIR: JOHN MCBRIDE
CO-CHAIR: ROBERT JACKSON

5.1 Single and Multi-Spot Current Density Distribution
Robert Malucci, Robert Malucci Consulting

5.2 The Influence of Phase Transformations on Welding Contact Closure
Stanislav Kharin, Kazakh-British Technical University

5.3 Research on the Calculation Method for the Enclosed Isolated Phase Bus-bar in Short-circuit Condition
Jiaxin You, Ruichao Wang and Huimin Liang, Harbin institute of Technology; Longqing Bao and Hongjian Wang, Shandong Alfa Dachi Electric Co. Ltd

6:30PM
SOCIAL EVENT
8:00AM – 9:20AM

ARCING CONTACTS II
CHAIR: JERRY WITTER
CO-CHAIR: Z.K. CHEN

6.1 Experimental Study on Electric Resistance of Tilted Contact in Air Circuit Breaker
Jianyu Qu and Xingwen Li, Xi’an Jiaotong University;
Qian Wang, Xi’an University of Technology

6.2 Break Arc Duration Characteristics of AgSnO2 Contacts under Magnetic Field Application with Contact Opening Speeds in the Range up to 200mm/s in DC Load Conditions
Makoto Hasegawa and Seika Tokumitsu, Chitose Institute of Science & Technology

6.3 Impact of the Gas Environment on the Electric Arc
Daniel Grogg and Clemens Schrank, TE Connectivity

6.4 Model Switch Experiments for Determining the Evolution of Contact Resistance of Electrical Contacts in Contactors
Diego Gonzalez, Frank Berger, Marcus Hopfeld, and Peter Schaaf, Technische Universität Ilmenau

9:20AM – 9:50AM
BREAK

9:50AM – 12:00PM

MORTON ANTLER LECTURE
INTRODUCTION BY GERALD WITTER

12:00PM – 13:30 PM
AWARDS LUNCHEON

13:50PM – 15:10PM
FRETTING / SLIDING
CHAIR: Koichiro Sawa
CO-CHAIR: ED SMITH

7.1 Sliding Friction, Wear, and Tribofilm Formation of Silver Films Electro-plated on Cu Alloy Sheets
Song-Zhu Kure-Chu, Rie Nakawaga, Toru Ogasawara and Hitoshi Yashiro, Iwate University;
Shigeru Sawada, Atsushi Shimizu and Yasushi Saitoh, AutoNetworks Technologies, Ltd
7.2 Microstructure of Fretting Debris on Tin-plated Terminals
Keiji Mashimo, Satoshi Yamazaki, Atsushi Shimoyamada, Hideo Nishikubo, Yujin Hori and Hirokazu Sasaki, Furukawa Electric Co., Ltd

7.3 A Study on Axial Vibration-induced Fretting Corrosion in Electrical Connector Pair
Fuxi Zhang, George T. Flowers, Robert N. Dean and Jeffrey Suhling, Auburn University; Jinchun Gao, University of Posts and Telecommunications Beijing

7.4 Capacitance Build-up in Electrical Connectors due to Vibration Induce Fretting Corrosion
Haoyue Yang, Yang Tong, George T. Flowers and Zhongyang Cheng, Auburn University

15:10PM – 15:40PM
BREAK

15:40PM – 17:00PM
MODELING II
CHAIR: BOB MALUCCI
CO-CHAIR: MAKOTO HASEGAWA

8.1 The Repulsion or Blow-Off Force between Closed Contacts Carrying Current
Erik D. Taylor, Siemens AG; Paul G. Slade, Consultant

8.2 Simulation on Dwell Stage of Arcs in Bridge Type Contacts for High-voltage DC Relay
Kai Bo, Xue Zhou, Guofu Zhai and Xinlei Qiao, Harbin Institute of Technology

8.3 Electrical Lifespan Prediction of High-voltage Direct-current Relay based on Arc Charge Accumulation
Xinglei Cui, Xue Zhou and Mo Chen, Harbin Institute of Technology; Luo Fubiao, Zhefeng Zhou, G&A Technology Co., Ltd.

8.4 Study on Thermal Characteristics of RF Coaxial Switch Based on Finite Element Method
Le Xu, Sanqiang Ling, Rao Fu and Guofu Zhai, Harbin Institute of Technology

8.5 Simple 1D Model of a Short Gap DC Electric Arc in Aeronautical Pressure Conditions
Redouane Boukadoum, Antonin Barbet, Philippe Dessante, Romaric Landfried, Thierry Leblanc and Philippe Teste, Université Paris-Sarclay

17:00PM
TC1 MEETING
CHAIR: G. WITTER
8:00AM – 9:50AM
MATERIALS AND FUNDAMENTALS
CHAIR: BRETT RICKETT
CO-CHAIR: DAVID WILLIAMS

9.1 Tin Plating Evaluation as a Potential Alternate to Silver Plating in Plug-in Connection for Low Voltage Low Amp Circuit Breakers
Mario Munoz, Hai Chen and Jesus Hernandez, Siemens Industry, Inc.

9.2 An Analysis of Generated Fractal and Measured Rough Surfaces
Xiaohan Zhang, Yang Xu and Robert Jackson, Auburn University

9.3 Study on Contact Spots of Fractal Rough Surfaces Based on Three-Dimensional Weierstrass-Mandelbrot Function
Junxing Chen, Fei Yang, Kaiyu Luo, Yi Wu, Chunping Niu and Mingzhe Rong, Xi’an Jiaotong University

9.4 Influence of Systematic Coefficient of Thermal Expansion (CTE) Variations on Sn Whiskering
Erica K. Snipes, George T. Flowers and Michael J. Bozack, Auburn University

9.5 The Investigation of Graphene Film as a New Electrical Contact Material

9:50AM – 10:20AM
BREAK

10:20AM – 11:20AM
RELAYS / ARCING
CHAIR: JOHN SHEA
CO-CHAIR: TIMO MUTZEL

10.1 Various Characteristics of Electromagnetic Contactor when Arc Discharge are Generated only Make Arc
Kiyoshi Yoshida, Shu Shimotsuma and Koichiro Sawa, Nippon Institute of Technology; Kenji Suzuki and Koetsu Takaya, Fuji Electric FA Components & Systems Co., Ltd.
10.2 Over-current Performance of Movable Springs of a Latched-type Relay Used in Watt-Hour Meters
Xue Zhou, Qingnan Li and Guofu Zhai, Harbin Institute Of Technology; Liwen Chen, G&A Electronics Ltd.Co.

10.3 Investigations on the Make-welding Behavior of High Power Contactors for AC and DC-Applications up to 3 kV
Jens Jebramcik and Frank Berger, Technische Universität Ilmenau

11:20AM
CLOSING REMARKS
Z. K. CHEN
<table>
<thead>
<tr>
<th>Author</th>
<th>Index</th>
</tr>
</thead>
<tbody>
<tr>
<td>Barbet, Antonin</td>
<td>20</td>
</tr>
<tr>
<td>Bao, Longqing</td>
<td>18</td>
</tr>
<tr>
<td>Berger, Frank</td>
<td>19, 22</td>
</tr>
<tr>
<td>Bianchetti, Romeo</td>
<td>16</td>
</tr>
<tr>
<td>Bo, Kai</td>
<td>20</td>
</tr>
<tr>
<td>Boukadoum, Redouane</td>
<td>20</td>
</tr>
<tr>
<td>Bozack, Michael</td>
<td>21</td>
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<tr>
<td>Brunel, David</td>
<td>17</td>
</tr>
<tr>
<td>Chen, Hai</td>
<td>21</td>
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<tr>
<td>Chen, Junxing</td>
<td>21</td>
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<td>Chen, Liwen</td>
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<td>Chen, Mo</td>
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<td>Chen, Silei</td>
<td>16</td>
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<tr>
<td>Cheng, Zhongyang</td>
<td>20</td>
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<tr>
<td>Chrétien, Pascal</td>
<td>17</td>
</tr>
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<td>Cui, Xinglei</td>
<td>20</td>
</tr>
<tr>
<td>Dean, Robert</td>
<td>20</td>
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<td>Delachaux, Thierry</td>
<td>16</td>
</tr>
<tr>
<td>Dessante, Philippe</td>
<td>20</td>
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<td>Fjeld, Elin</td>
<td>17</td>
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<tr>
<td>Flowers, George</td>
<td>16, 20(2), 21</td>
</tr>
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<td>Franke, Jörg</td>
<td>18</td>
</tr>
<tr>
<td>Friberg, Andreas</td>
<td>16</td>
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<td>Fu, Rao</td>
<td>20</td>
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<tr>
<td>Fubiao, Luo</td>
<td>20</td>
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<td>Gan, Yixiang</td>
<td>16</td>
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<td>Gao, Jinchun</td>
<td>16, 20</td>
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<td>Glässel, Tobias</td>
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<td>Gonzalez, Diego</td>
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<td>Grogg, Daniel</td>
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<td>Hanaor, Dorian</td>
<td>16</td>
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<td>Hasegawa, Makoto</td>
<td>19</td>
</tr>
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<td>Haas, Raphael</td>
<td>18</td>
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<td>Hayakawa, Tatsuya</td>
<td>17</td>
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<td>Hernandez, Jesus</td>
<td>21</td>
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<td>Hopfeld, Marcus</td>
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<td>Hori, Yujin</td>
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<td>Houzé, Frédéric</td>
<td>17</td>
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<td>Jackson, Robert</td>
<td>16, 21</td>
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<tr>
<td>Jaffré, Alexandre</td>
<td>17</td>
</tr>
<tr>
<td>Jaumann, Andreas</td>
<td>18</td>
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<td>Jebramnick, Jens</td>
<td>22</td>
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<td>Ji, Rui</td>
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<td>Jin, Qiuyan</td>
<td>16</td>
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<td>Kawabata, Sumiko</td>
<td>17, 21</td>
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<td>Khari, Stanislav</td>
<td>18</td>
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<td>Kondo, Takaya</td>
<td>17</td>
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<td>Kreitlein, Sven</td>
<td>18</td>
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<tr>
<td>Kure-Chu, Song-Zhu</td>
<td>19</td>
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<td>Kubo, Toshitaka</td>
<td>21</td>
</tr>
<tr>
<td>Landfried, Romaric</td>
<td>20</td>
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<td>Leblanc, Thierry</td>
<td>20</td>
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<td>Li, Qingnan</td>
<td>22</td>
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<td>Li, Xingwen</td>
<td>16, 19</td>
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<td>Liang, Huimin</td>
<td>18</td>
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<td>Ling, Sanqiang</td>
<td>20</td>
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<td>Liu, Hong</td>
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<td>Luo, Kaiyu</td>
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<td>Malucci, Robert</td>
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<td>McBride, John</td>
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<td>Meyyappan, Karumbai</td>
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<td>Mori, Kikuo</td>
<td>17, 21</td>
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<td>Munoz, Mario</td>
<td>21</td>
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<td>Nakagawa, Rie</td>
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<td>Nishikubo, Hideo</td>
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<td>Noël, Sophie</td>
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<td>Ogasawara, Toru</td>
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<td>Oide, Tamanosuke</td>
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<td>Onuma, Masanori</td>
<td>17</td>
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<td>Proust, Gwénaëlle</td>
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</tr>
<tr>
<td>Qiao, Xinlei</td>
<td>20</td>
</tr>
<tr>
<td>Qu, Jianyu</td>
<td>19</td>
</tr>
</tbody>
</table>
Rodriguez, Juan Jose 17
Rondeel, Wilhelm 17
Rong, Mingzhe 21
Saha, Swarna 16
Saitoh, Yasushi 19
Sasaki, Hirokazu 20
Sawa, Koichiro 21
Sawada, Shigeru 19
Saxegaard, Magne 17
Schaaf, Peter 19
Schinow, Vitali 16
Schrank, Clemens 19
Shimizu, Atsushi 19
Shimizu, Tetsuo 17,21
Shimotsuma, Shu 21
Shimoyamada, Atsushi 20
Slade, Paul G. 10, 20
Snipes, Erica K. 21
Song, Jian 16
Spahr, Michael 18
Spreng, Simon 18
Suhling, Jeffrey 20
Süetterlin, Patrick 16
Suzuki, Kenji 21
Takada, Hijime 21
Takaya, Koetsu 21
Takeuchi, Nozomi 17
Tanaka, Miyuki 21
Taylor, Eric 20
Testé, Philippe 20
Tokumitsu, Seika 19
Tong, Yang 20
Toyoizumi, Jun 17
Vasudevan, Vasu 18
Vujosevic, Milena 18
Wang, Hongjian 18
Wang, Qian 19
Wang, Ruichao 18
Watanabe, Norimichi 17
Williams, David 18
Wu, QiFeng 18
Xie, Gang 16
Xu, Le 20
Xu, Yang 21
Yamasaki, Satoshi 20
Yang, Haoyue 20
Yang, Fei 21
Yashiro, Hitoshi 19
Yasuoka, Koichi 17
Yoshida, Kiyoshi 21
Yoshiki, Tsuboi 17
You, Jiaxin 18
Yuan, Haomiao 16
Yudate, Takahiro 17
Zhai, Chongpu 16
Zhai, Guofu 20 (2),22
Zhang, Fuxi 20
Zhang, Xiaohan 21
Zhou, Xue 20 (2),22
Zhou, Zhefeng 20