Final Program

29th International Conference on Electrical Contacts

together with

64th IEEE Holm Conference on Electrical Contacts

14-18 OCTOBER 2018
Hotel Albuquerque
Albuquerque, NM, USA

Sponsored By:
The Electronics Packaging Society of The Institute of Electrical and Electronics Engineers, Inc.

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Prof. J. -G. Zhang, **Emeritus Member**

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 29th International Conference on Electrical Contacts together with the 64th IEEE Holm Conference will include excellent papers authored by outstanding technical people in this field. The international contributors come from Canada, China, France, Germany, India, Iran, Japan, Kazakhstan, Mexico, Norway, Sweden, Switzerland, United Kingdom and 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.

Prior to this, the 4-day Intensive Course on Electrical Contacts will be held on October 10-13, 2018 in the same location. The course covers all aspects of Electrical Contacts, including:

- Contact fundamentals and materials
- Friction, wear, fretting and lubrication
- Electric arc fundamentals and dynamics
- Power and electronic connector technologies
- Guidelines for electrical and electronic connector design

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 13	After August 13
IEEE Member	US$800	US$875
Non- Member	US$875	US$950
Student/Life Member	US$350	US$400

See the registration site for INTENSIVE COURSE registration fees and combined Course/Conference rates.

CONFERENCE REGISTRATION HOURS

Sunday 14 October	4:00PM – 6:00PM
Monday 15 October	7:00AM – 5:00PM
Tuesday 16 October	8:00AM – 4:00PM
Wednesday 17 October	8:00AM – 4:00PM

Registration can be completed online:

http://www.cvent.com/d/d4qqz3

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, 14 October from 4:00 PM – 6:00 PM at the Franciscan Room of the Hotel Albuquerque.

Hotel Accommodations

The 2018 conference meets in Albuquerque, New Mexico at the Hotel Albuquerque, where meeting facilities are well suited to the conference sessions and other activities. The hotel is offering special rates of US$179* single/double occupancy to conference attendees. Rates are subject to state and local tax. To make a reservation please use the Holm Conference link

http://www.ieee-holm.org/h2018/h2018hotel.html

or call the Hotel Albuquerque Reservations 1- 505-843-6300, and please refer to the group name as "1810IEEE" in order to receive the group rate. The rate is valid until **September 18th 2018** at 5:00PM MST. 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 provided you cancel your room before 6pm, 3 days prior to arrival.

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

Hotel Albuquerque
800 Rio Grande Blvd. NW17th St
Albuquerque, NM 87104 USA
+1 (505) 843-6300

Transportation

Airport and Driving Directions:

FROM ALBUQUERQUE INTERNATIONAL SUNPORT AIRPORT – 20 MINUTES/7.5 MILES
Merge onto I-25 N via the ramp and continue for 3.5 miles. Take exit 226AB to merge onto I-40 West toward Gallup, and continue for another 2.5 miles. Take Exit 157A for Rio Grande Blvd, turn left onto Rio Grande Blvd. Continue for 0.3 miles. The Hotel Albuquerque will be on the left.

For specific driving directions consult:

http://www.ieee-holm.org/h2018/h2018hotel.html

or call the hotel directly at +1 (505) 843-6300.

Conference Banquet

The Albuquerque Museum

17 October 2018 6:30PM

The Albuquerque Museum highlights the city's rich heritage with exhibits depicting the art, history and culture of the American Southwest.

The ICEC/Holm Banquet will be held in the museum's Grand Lobby and select exhibits will be open for viewing.

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

ICEC/Holm Conference Companion Program

For companions not attending the technical sessions, several social activities are available throughout the course of the conference. Detailed description of the activities can be seen by clicking on "Companion Program" at:

http://www.ieee-holm.org/

For additional information during the conference, please visit the registration desk.

15 October 2018

10:00am Docent led Walking tour of Old Town (Free)
Docents from the Albuquerque Museum will lead a 1 - 1 ½ hour walking tour spotlighting the history, architectural and cultural influences surrounding the plaza's past and present.

12:00pm Lunch at the Church St Café (self-pay)
Enjoy authentic southwestern fare. Vegetarian and gluten free options are available. https://www.churchstreetcafe.com/

16 October 2018

9:00am – 5:00pm Santa Fe Tour ($48.00 per person) Includes: transportation, tour guide, admission to Loretto Chapel Museum.

17 October 2018

9:00 – 1:00pm Acoma Pueblo Tour ($70.00 per person) Includes: transportation, professional tour guide, bottled water, hydrating beverages & snacks, all admission costs and photo permit. Located 1 hour west of Albuquerque, Acoma Indian Pueblo "Sky City", is built upon a 70-acre mesa almost 40 stories above the canyon floor.

Please indicate which tours you'll be attending including Monday lunch by September 21st. If minimum number of 10 is not met the Santa Fe and Acoma tours may be cancelled. We also need to know numbers for the restaurant. Sign up by sending an email including number of participants to:

companion2018@ieee.org

Walking tour Old Town	Yes___	No___
Church St. Café Lunch	Yes___	No___
Experience Santa Fe	Yes___	No___
Acoma Pueblo "Sky City" Tour	Yes___	No___

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 Nominations Committee, c/o IEEE Holm Conference Planner, 445 Hoes Lane, Piscataway, NJ 08854 USA

2019 Nominations Deadline: 1 February 2019

The 2018 Armington Recognition Award

The Armington Recognition Award was established in honor of Dr. Ralph Armington, who organized the first Holm Seminar on Electrical Contacts in 1953 and established the framework that sustains the conference which is now known as the IEEE Holm Conference on Electrical Contacts. The Armington Recognition Award is presented to individuals who have made significant contributions for sustaining the quality of the IEEE Holm Conference. This includes service on the technical, prize paper, operating, awards, and steering committees

2018 ARMINGTON RECOGNITION AWARDEE
ZHUAN-KE CHEN

Dr. Zhuan-Ke Chen (M'1995–SM'2011) received the B.S. and M.S. degrees in electronic engineering from Xi'an Jiaotong University, China in 1982 and 1985, respectively, and Ph. D degree in electrical engineering from Keio University, Japan, in 1995. From 1985 to 1991, he was with the department of electronic engineering of Xi'an Jiaotong University, where he taught several courses in electronic physics, gas discharge theory, and cathode electronics. At that time, he was engaged in research on electromagnetic relays and numerical calculation of electromagnetic fields using FEM. From 1991 to 1995, he received the Monbusho Scholarship from the Ministry of Education, Science, and Culture of Japan, and studied at the electrical engineering department of Sawa laboratory in Keio University, Japan. He focused on the material transfer and contact resistance deterioration of electrical contacts under arc condition and mechanical wear of electrical contacts. Dr. Chen joined Electrical Contacts Plus, LLC (formerly Chugai USA, Inc.) in 1996 as a research engineer researching silver metal oxide materials in automotive applications and AC relays and switches, becoming vice president in 2003. He has over 50 conference and journal publications in the areas of arc erosion, contact resistance, and contact materials.

Dr. Chen has been actively involved with the Holm Conference since 1992, serving in various roles including the prize paper and technical program committees since 2003. He served as Technical Program Committee Chairman from 2010-2011 and Conference chairman from 2015-2016.

Holm 2019

The 65th IEEE Holm Conference on Electrical Contacts

The 65th IEEE Holm Conference on Electrical Contacts will be held from September 15-18, 2019 at the Pfister Hotel, Milwaukee, W I , USA.

IEEE uploads the Holm Conference Proceedings to all relevant databases including the Engineering Index. Prospective authors should submit a brief abstract (200 words maximum) online before February 8 , 2019. For abstract submissions and the latest information regarding the conference, please visit the Holm Conference Website at:

www.ieee-holm.org

IMPORTANT DATES

February 8, 2019	Abstract Deadline
February 22, 2019	Notification of Acceptance
April 19, 2019	Completed Paper Deadline
September 15, 2019	Conference Begins

CORRESPONDENCE ADDRESS

IEEE Meeting & Conference Management 65th IEEE Holm Conference (2019)
445 Hoes Lane
Piscataway, NJ 08854
tel: +1 800 810 4333 or
fax: +1 732 465 6447
email: holmreg@ieee.org

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.

Advances in Battery Technologies for Electric Vehicles and Grid Storage

BABU CHALAMALA
Manager of Energy Storage Technology and Systems Department at Sandia National Laboratories

Abstract:
As we look into the future, electrical energy storage technology has the potential to transform nearly every aspect of how we use electrical energy, especially electrification of transportation, large scale integration of renewable resources, and for modernization of the electric grid. The goals are low cost storage systems, high energy density, safety, and reliability for all size systems. Current systems have limitations like limited battery life, slow charging rates, and safety issues. Unlike electronic devices that rely on electronic processes in semiconductors, batteries depend on electrochemical conversion processes. The paper gives an overview of rechargeable battery technologies discussing advances in Li-ion batteries and lead acid batteries. It also will discuss emerging technologies such as flow batteries, and sodium and zinc based batteries. It will also include systems engineering aspects in engineering energy storage systems. The paper will include recent developments and what the future holds for new battery development.

Erle Shobert Prize Paper

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.

2017 IEEE Erle Shobert Prize Paper Award

New LITESURF Plating for the Mitigation of Whisker Risks in Press-Fit Applications

Erika R. Crandall, TE Connectivity, Germany; Frank Schabert, TE Connectivity, Germany; Helge Schmidt, TE Connectivity, Germany; Martin Bleicher, TE Connectivity, Germany; Thomas Fili, TE Connectivity, Germany; Walter E. Mueller - von Fischer, TE Connectivity, Germany; Claus Borhauer, TE Connectivity, Germany; Stefan Thoss, TE Connectivity, Germany; Jorge Villarreal, TE Connectivity, Germany and Bart Kerckhof, TE Connectivity, Belgium

2017 Paul and Dee Dee Slade Young Investigator

The Paul and Dee Dee Slade Young Investigator Award was established in 2011 with the objective to recognize outstanding achievement of young investigators in the field of Electrical Contacts and to encourage young scientists and engineers to enter this field. To be eligible for the Award, the candidate must be under the age of 35 as of the closing date of the conference, and present a paper at the conference in which s/he is either the sole author or the first author of a multi-author paper. The award is presented at the conference awards luncheon and will be prominently mentioned in the proceedings of the following conference.

2017 Paul and Dee Dee Slade Young Investigator Award

Study of the Electric Arc in DC Contactors: Modeling, Simulation and Experimental Validation

M. Buffo, J.P. Martin, S. Saadate, University of Lorraine
J. Andrea, N. Dumoulin, E. Guillard, Esterline Power Systems

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Technical Program

MONDAY, 15 October 2018

8:00AM
INTRODUCTION AND OPENING REMARKS
ROD MARTENS, 2018 ICEC/Holm Conference Chair

8:10AM – 10:00AM
YOUNG INVESTIGATOR SESSION
CHAIR: ROBERT JACKSON
CO-CHAIR: DAVID WILLIAMS

1.1 Investigations on the Effects of Different Strand Surface Conditions on the Inter Strand and Strand/Connector Resistance
Carsten Kuckuck[1,2], Michael Blauth[1], Jian Song[2]
[1]Phoenix Contact GmbH & Co, [2]Ostwestfalen-Lippe University of Applied Sciences

1.2 The Impact of Coating Materials in Coaxial Connectors on Passive Intermodulation
Jin Qiuyan[1,2], Jinchun Gao[1], George Flowers[2], Gang Xie[1], Xiangwen Wu[3]
[1]Beijing University of Posts and Telecommunications, [2]Auburn University, [3]Forstar S&T Co., Ltd.

1.3 The Influence of Contaminated Copper Wires on the DC Joule Heating of Connectors
Tobias Dyck[1] and Andreas Bund[2]
[1]WAGO Kontakttechnik GmbH & Co, [2]Technische Universitat Ilmenau

1.4 Theoretical and Experimental Work on Optimal Contact Geometries for Fast Mechanical Disconnect Switches
Tushar Damle and Lukas Graber, Georgia Institute of Technology

1.5 Improved Microcontact Testing Fixture for Efficient Reliability and Performance Characterization
Protap Mahanta and Ronald Coutu, Marquette University

10:00AM – 10:25AM BREAK

10:25AM – 11:25AM
FUNDAMENTALS
CHAIR: KARUMBU MEYYAPPAN
CO-CHAIR: ROLAND TIMSIT

2.1 The Model of Melting and Welding of Closed Electrical Contacts with Softening Contact Zone
Stanislav Kharin[1], Merey Sarsengeldin[2], Samat Kassabek[3], Targyn Nauryz[1], [1]Kazakh-British Technical University, [2]Kazakh National Polytechnic University, [3]Suleiman Demirel University

2.2 The Effects of Bridge Structures on Current Density and Temperature Distributions
Robert Malucci, RD Malucci Consulting

2.3 A Multiphysics Coupled Electro-thermo-mechanical Model of Whisker Shorting
Robert Jackson[1] and Erika R. Crandall[2],
[1]AuburnUniversity, [2]TE Connectivity

11:25AM – 11:50AM
BREAK

11:50AM – 12:50PM
Modelling I
CHAIR: JOHN MCBRIDE
CO-CHAIR: STANISLVAV KHARIN

3.1 3-D Hydrodynamic Model of Metal Droplet Sputtering and Molten Pool Formation under Electric Arc
Xiaoyu Liao, Xue Zhou, Kai Bo, Guofu Zhai, Harbin Institute of Technology

3.2 Modeling of the Friction Force in Sliding Electrical Contact with Mining Rules
Lichuan Hui[1], Zhonghua Chen[1], Fengyi Guo[1], Guojun Sun[2], 1Liaoning Technical University,
[2]Shuozhou Power Supply Company of the State Grid Corporation of China

3.3 Parameter Estimation of Black Box Arc Model based on Heuristic Optimization Algorithms
Guogang Zhang[1], Yakui Liu[1], Lu Qi[1], Youdang Xu[1], Michael Kurrat[2]
[1]Xi'an Jiaotong University, [2]Technical University Braunschweig

12:50PM – 1:50PM Lunch (on your own)

1:50PM – 3:10PM
ARCING I
CHAIR: XIN ZHOU
CO-CHAIR: TIMO MUETZEL

4.1 Weldings in Break and Make Operations for CuMo and CuW Contact Materials in DC200-500V and Different Surrounding Gases
Yuan Liao[1], Lige Zhang[1], Zhenbiao Li[1], Qingcheng Zhu[1], Makoto Hasegawa[2]
[1]Huazhong University of Science and Technology, [2]Chitose Institute of Science and Technology

4.2 Effect of Contact Velocity on the Behavior of Decaying Arcs in Air
Mrunal Parekh[1], Jesper Magnusson[2], Marley Becerra[1,2], Göran Engdahl[1]
[1]KTH Royal Institute Of Technology, [2]ABB AB Corporate Research

4.3 **Arc Behaviors of Three Kinds of Bridge-type Contacts when Opening a Resistive Load in Range of from 300VDC to 750VDC**
Huimin Liang[1], Delong Liu[1], Xue Zhou[1], Xiaoyu Liao[1], Dan Chen[2], Zhaowen Cai[2], Shuqing Chen[2]
[1]Harbin Institute of Technology, [2]G&A Technologies Co., Ltd.

4.4 **Effective Shortening of Break Arc Durations of Ag and Several Ag-Based Contacts in DC Load Conditions with Increased Contact Opening Speeds and External Magnetic Field**
Seika Tokumitsu and Makoto Hasegawa, Chitose Institute of Science and Technology

3:10PM – 3:35PM
BREAK

3:35PM – 4:55PM
CIRCUIT BREAKERS
CHAIR: GUANG YANG
CO-CHAIR: ROD MARTENS

5.1 **Study of DRM during Closing Period of High Voltage Circuit Breaker**
Yakui Liu[1], Guogang Zhang[1], Hao Qin[1], Zhengxiang Song[1], Jianhua Wang[1], Jinggang Yang[2]
[1]Xi'an Jiaotong University, [2]Jiangsu Electric Power Company Research Institute

5.2 **Impact of Surface Morphology on Arcing Induced Erosion of CuW Contacts in Gas Circuit Breakers**
Milad Mohammadhosein[1], Kaveh Niayesh[1], Amir Abbas Shayegani Akmal[1], Hossein Mohseni[2]
[1]University of Tehran, [2]Norwegian University of Science and Technology

5.3 **Bi-directional DC Circuit Protection Technology for Photovoltaic Applications**
Xin Zhou, Eaton Corporation

5.4 **Current Carrying Capacity of an Earthing Switch for a Generator Circuit Breaker**
Alberto Zanetti and Jean-Claude Mauroux, ABB Schweiz AG

5:00PM – 6:00PM
TC1 MEETING
CHAIR: GERALD WITTER

6:00PM – 8:00PM
Poster Session I
CHAIR: PETER HALE

P1.1 **Simulation and Experimental Research on Electrical Properties of $AgSnO_2$ Contact Materials Doped with Rare Earth Element Ce**
Jingqin Wang[1], Ying Zhang[1], Huiling Kang[1], Yanyan Luo[1], Jiaomin Liu[2] [1]Hebei University of Technology, [2]Tianjin Electronic Information Advanced Technical School

P1.2 **Virtual prototype and Optimal Design of Short Circuit Current Capability of Magnetic Latching Relay**
Hao Yu, Huimin Liang, Kai Bo, Xuerong Ye, Guofu Zhai, Harbin Institute of Technology

P1.3 **A XANES Study of Natural Oxide Films on Plated Tin**
Keiji Mashimo, Yujin Hori, Satoshi Yamazaki, Furukawa Electric Co., Ltd.

P1.4 **Experimental Study and Feature Improvement of DC Series Arc Faults with Switching Noise Interference**
Silei Chen, Xingwen Li, Xi'an Jiaotong University

P1.5 **Application of the Preference Set-based Design Method to Cantilever for Electrical Contact**
Yoshiki Kayano[1], Kazuaki Miyanaga[2], Hiroshi Inoue[1], Yoshio Kami[1] [1]The University of Electro-Communications, [2]Fujitsu Component Limited

P1.6 **Relationship between Wear Profile of Pantograph Contact Strip and Arc Discharge Energy Distribution**
Yoshitaka Kubota, Railway Technical Research Institute

P1.7 **Development of 126kV Single-break Vacuum Circuit Breaker**
Haomin Li, Yingsan Geng, Zhiyuan Liu, Jianhua Wang, Xi'an Jiaotong University

P1.8 **Contact Voltage Drop and Brush Wear Characteristics for Various Silver Content of the Silver Graphite Brush in Slip Ring System**
Naoki Fukuda, Koichiro Sawa, Takahiro Ueno, Nippon Institute of Technology

P1.9 **Investigations on the Effects of Different Strand Surface Conditions on the Inter Strand and Strand/Connector Resistance**
Carsten Kuckuck[1,2], Michael Blauth[1], Jian Song[2] [1]Phoenix Contact GmbH & Co, [2]Ostwestfalen-Lippe University of Applied Sciences

P1.10 **The Impact of Coating Materials in Coaxial Connectors on Passive Intermodulation**
Jin Qiuyan[1,2], Jinchun Gao[1], George Flowers[2], Gang Xie[1], Xiangwen Wu[3]
[1]Beijing University of Posts and Telecommunications, [2]Auburn University, [3]Forstar S&T Co., Ltd.

8:00AM – 09:20AM
MATERIALS
CHAIR: DEEPAK PATIL
CO-CHAIR: THOMAS SCHOEPF

6.1 **Contact Material Solutions for LED Lamp Application**
Timo Muetzel and Christian Hubrich, Saxonia Technical Materials GmbH

6.2 **Study on Cu-W Clad Contact Materials with Arc-less Current Commutation in a Hybrid DC Switch**
Mo Chen, Yuta Yamada, Shungo Zen, Nozomi Takeuchi, Koichi Yasuoka, Tokyo Institute of Technology

6.3 **A Novel Method Based in Nanotechnology to Replace Traditional Brazing Methods Used to Weld Electrical Contacts**
Perla Rodriguez[1], Juan Jose Rodriguez[1], Eduardo Cardenas[2], [1]Siemens SA, [2]ITESM-Monterey

6.4 **Switching Behavior of Ag/SnO_2 Contact Materials at High Operating Overload Currents**
Havva Cinaroglu, Volker Behrens, Thomas Honig, DODUCO GmbH

9:20AM – 9:45AM
BREAK

9:45AM – 10:45AM
MORTON ANTLER LECTURE

Advances in Battery Technologies for Electric Vehicles and Grid Storage
Babu Chalamala, Sandia National Laboratories

10:45AM – 11:10AM BREAK

11:10AM – 12:30PM
DC ARCING
CHAIR: Xinwen Li
CO-CHAIR: Guenther Horn

7.1 **Influence of Arc Discharge on Contact Erosion and Contact Resistance in a Hybrid DC Switch**
Chomrong Ou, Ryo Nakayama, Shungo Zen, Nozomi Takeuchi, Koichi Yasuoka, Tokyo Institute of Technology

7.2 **Influence of Magnetic Flux Density on "Magnetic Blow-out" of Direct Current High Voltage Arc**
Kiyoshi Yoshida[1], Koichiro Sawa[1,2], Kenji Suzuki[3]
[1]Nippon Institute of Technology, [2]Keio University, [3]Fuji Electric FA Components & Systems Co., Ltd.

7.3 DC Arc Properties in a DC Magnetic Field
John Shea, Elissa Heckman, José C. Suárez Guevara, Schneider-Electric

7.4 Hybrid Circuit Breaker-based Fault Detection and Interruption in 380V DC Test-setup
Christoph Klosinski[1], Dirk Bösche[1], Patrick Ross[1], Nasser G. A. Hemdan[1], Michael Kurrat[1], Johann Meisner[2], Stephan Passon[2], Alexander Heinrich[2], Frank Gerdinand[3], [1]Technische Universität Braunschweig, [2]PTB Physikalisch-Technische Bundesanstalt, [3]E-T-A Elektrotechnische Apparate GmbH

12:30PM – 1:30PM
Lunch (on your own)

1:30PM – 2:50 PM
ARCING II
CHAIR: ZK CHEN
CO-CHAIR: KOICHIRO SAWA

8.1 Numerical Study of Arc Motion Process Considering Ferromagnetic Material in Multiple Parallel Contacts System
Baoliang Zhang[1], Jianning Yin[2], Penghe Zhang[1], Xingwen Li[2], Qian Wang[3], Guobin Hou[2], Xiaofeng Deng[2], [1]China Electric Power Research Institute Co., Ltd., [2]Xi'an Jiaotong University, [3]Xi'an Univ of Technology

8.2 Investigation on Vacuum Arc Dynamics and Discharge Transition Modes under Different Conditions
Diego Gonzalez, Sergey Gortschakow, Steffen Franke, Ralf Methling, D. Uhrlandt
Leibniz Institute for Plasma Science and Technology

8.3 Arc Modeling to Predict Arc Extinction in Low Voltage Switching Devices
Dongkyu Shin, John W. McBride, IgorO. Golosnoy, University of Southampton

8.4 Emission Currents and Late Restrikes After Switching Capacitors using Vacuum Interrupters
Paul G. Slade[1], Erik D. Taylor[2], [1]Consultant, [2]Siemens AG

2:50PM – 3:15PM
BREAK

3:15PM – 4:15PM
MODELLING II
CHAIR: DAVID WILLIAMS
CO-CHAIR: HELENE GAUTHIER

9.1 **Parameter Study on the Electrical Contact Resistance of Axially Canted Coil Springs for High-current Systems**
Thomas Schriefer[1], Maximilian Hofmann[2], Hubert Rauh[2], Bernd Eckardt[2], Martin März[1,2], [1]University of Erlangen-Nuremberg, [2]Fraunhofer Institute for Integrated Systems and Device Technology

9.2 **Generation of Overvoltages by Chop Current on Ag-WC and Cu-W/WCContacts in Vacuum**
Erik Taylor, Klaus Niemeyer, Christian Pietsch, Siemens AG

9.3 **On Partial Discharge/Corona Considerations for Low Voltage Switchgear and Controlgear**
Hans Weichert[1], Pascal Benz[1], Nicholas Hill[2], Michael Hilbert[2], Michael Kurrat[2]
[1]Rockwell Automation Switzerland GmbH, [2]Technische Universitat Braunschweig

8:00AM – 09:20AM
POWER CONNECTORS
CHAIR: DANIEL GAGNON
CO-CHAIR: PETER MECKLER

10.1 **The Influence of Peak Current and ECR on the Transmission Performance of High Power Connectors during Faults**
Toni Israel[1], Stephan Schlegel[1], Steffen Großmann[1], Tom Kufner[2], George Freudiger[2]
[1]Technische Universität Dresden, [2]Stäubli Electrical Connectors AG

10.2 **Influence of Oxygen on the Aging of Electrical Joints with One Bare and One Coated Aluminum Contact Member**
Marcella Oberst, Stephan Schlegel, Steffen Großmann, Technische Universität Dresden

10.3 **Recent Findings in the Long-Term and Short Circuit Behavior of Power Connections and their Relevance for Testing**
Christian Hildmann, Toni Israel, Stephan Schlegel, Steffen Großmann, Technische Universität Dresden

10.4 **Effects of High-Speed Signals on Power Integrity**
Stephen Smith[1], Khushboo Patel[1], Joseph Cin[1], Sedig Agili[2], Jeffrey Walden[3],
[1]Amphenol Corporation, [2]Pennsylvania State University, [3]Walden and Associates EMC/SI RF Consulting

9:20AM – 9:45AM
BREAK

9:45AM – 11:05AM
FRETTING
CHAIR: ROBERT MALUCCI
CO-CHAIR: PETER BERGER

11.1 **AC Signal Modulation on Electrical Contacts due to Vibration Induced Fretting Corrosion**
Sanqiang Ling[1], Haoyue Yang[2], Xue Zhou[1], Le Xu[1], Donghui Li[1], Sai Wu[3], George Flowers[2]
[1]Harbin Inst of Technology, [2]Auburn University, [3]Hangzhou Aerospace Electronic Technology Co., Ltd.

11.2 **Occurrence and Influence of Fretting Corrosion on Receptacle Contact Resistance**
Matthias Friedlein, Daniel Gräf, Fabian Raiser, Andreas Jaumann, Jörg Franke
Friedrich-Alexander-University

11.3 **The Effects of Relative Humidity on the Fretting Wear Behavior of Silver-plated Electrical Contacts**
Florent Pompanon[1], Siegfried Fouvry[1], Olivier Alquier[2], [1]Ecole Centrale de Lyon, [2]PSA Groupe

11.4 **A Modification of the Calculation Model for the Prediction of the Wear of Silver-Coated Electrical Contacts with Consideration of Third Bodies**
Haomiao Yuan, Jian Song, Vitali Schinow, Ostwestfalen-Lippe University of Applied Sciences

11:05AM –11:30AM
BREAK

11:30AM – 12:50PM
SAFETY
CHAIR: HENRY CZAJKOWSKI
CO-CHAIR: JOHN SHEA

12.1 **Innovative Safety Concept to Shutdown Short Circuit Currents in Battery Systems Up to 1000V Based on Ultrafast Pyrofuse Technology**
Peter Lell[1] and Dieter Volm[2], [1]PyroGlobe GmbH, [2]Panasonic Electric Works Europe AG

12.2 **Influence of Perturbations Produced by Electromagnetic Interference (EMI) in Arc Fault Detection**
Edwin Calderon, Patrick Schweitzer, Christophs Bonnet, Serge Weber, Lorraine University

12.3 **Simulation of Arcing Fault in PV Panel Network**
Jonathan Andrea[1], D. Jung[1], Patrick Schweitzer[2], Benjamin Vidales[2], Edwin Calderon[2], Serge Weber[2] [1]Esterline Power Systems, [2]Lorraiune University

12.4 **Series Arc Fault Detection using Novel Signal Processing Technique**
Manaf Atharparvez and Kedar Purandare, Larsen and Toubro Limited

12:50PM – 1:50PM
Lunch (on your own)

1:50PM – 2:50PM
HIGH SPEED CONNECTORS
CHAIR: ROLAND TIMSIT
CO-CHAIR: WERNER JOHLER

13.1 **The Impact of Electrical Contact Degradation on Differential Signal Transmission of High Speed Channel**
Ziren Wang[1], Jinchun Gao[1], George Flowers[2], Gang Xie[1], Rui Ji[1] [1]Beijing University of Posts and Telecommunications, [2]Auburn University

13.2 **Statistical Passive Intermodulation Behavior on Coaxial Connector**
Xiong Chen[1], Keyue Zhang[1], Yongning He[1], Wanzhao Cui[2], Songchang Zhang[1], Yaojiang Zhang[3] [1]Xi'an Jiaotong University, [2]China Academy of Space Technology, [3]Global Compliance & Testing Center

13.3 **Study of Metal Contact Resistance and its Statistical Correlation with Passive Intermodulation**
Songchang Zhang, Xiaolong Zhao, Fan Gao, Yongning He, Xi'an Jiaotong University

2:50PM – 3:15PM
BREAK

3:15PM – 4:15 PM
MEMS
CHAIR: RON COUTU
CO-CHAIR: SOPHIE NOEL

14.1 **The Influence of Circuit Parameters on Molten Bridge Surface Degradation in a Au/MWCNT MEMS Switch Contact**
Thomas. G. Bull, John W. McBride, and Liudi Jiang, University of Southampton

14.2 **Investigation of the Static Electrical Contact Behaviors of Rod and Spring for Micro-electromechanical-relay**
Chao Zhang[1], Wenbo Fan[1], Wanbin Ren[1], Fubiao Luo[2] [1]Harbin Institute of Technology, [2]G&A Electronics Ltd. Co.

14.3 **On the Melting of Ohmic-Heated Nanowires and Electrical Contacts**
Roland S Timsit, Timron Scientific Consulting Inc.

4:20PM – 5:50PM
Poster Session II
CHAIR: PETER HALE

P2.1 **A Phenomenological Model of Vibrations Transfer in Connectors for Fretting Corrosion Phenomena**
Erwann Carvou[1], J. Labbé[1], L. Le Marrec[1], C. Plouzeau[2], F. Le Strat[2] [1]Université de Rennes, [2]Renault DEA-TCM

P2.2 **Evaluation and Comparison of the Arc Erosion Characteristic of Ag/SnO_2/In_2O_3 Contact Materials Used for an Automotive Relay**
Lei Yi[1], Ningyi Lu[2], [1]Xiamen Hongfa Electroacoustic Co., Ltd., [2]Zhejiang University

P2.3 **Study on V-I Characteristic in Natural Graphite Brush vs Steel Slip-Ring System**
Yuki Amada[1], Koichiro Sawa[1], Takahiro Ueno[1], Noboru Morita[2]
[1]Nippon Institute of Technology, [2]Motor & Carbon Brush Lab. Co. Ltd.

P2.4 **Study on Friction and Wear of Sliding Electrical Contact of Pantograph-catenary System under Fluctuating Compressive Load**
Zhonghua Chen, Guojun Sun, Guang Shi, Lichuan Hui, Liaoning Technical University

P2.5 **Mechanical Wear and Arc Erosion of Brush and Commutator in DC Motor for Automotive Fuel Pump**
Koichiro Sawa, Yoshitada Watanabe, Takahiro Ueno, Nippon Institute of Technology

P2.6 **Refined Fault Detection in LVDC-Grids with Signal Processing, System Identification and Machine Learning Methods**
Christian Strobl[1], Leopold Ott[2], Julian Kaiser[2], Kilian Gosses[2], Maximilian Schäfer[3], Rudolf Rabenstein[3] [1]Elektrotechnische Apparate GmbH, [2]Fraunhofer Institute for Integrated Systems and Device Technology, [3]Friedrich-Alexander-Universität Erlangen

P2.7 **Effect of Lubrication on DC and RF Electrical Endurance of Gold Plated Contacts Subjected to Fretting Wear**
Olivier Graton[1], Siegfried Fouvry[1], Richard Enquebecq[2], Laurent Petit[2]
[1]École Centrale de Lyon, [2]Radiall

P2.8 **The Influence of Contaminated Copper Wires on the DC Joule Heating of Connectors**
Tobias Dyck[1] and Andreas Bund[2]……[1]WAGO Kontakttechnik GmbH & Co, [2]Technische Universitat Ilmenau

P2.9 **Theoretical and Experimental Work on Optimal Contact Geometries for Fast Mechanical Disconnect Switches**
Tushar Damle and Lukas Graber, Georgia Institute of Technology

P2.10 **Improved Microcontact Testing Fixture for Efficient Reliability and Performance Characterization**
Protap Mahanta and Ronald Coutu, Marquette University

6:30PM
Conference Banquet - Albuquerque Museum

8:00AM – 09:00AM

SLIDING CONTACTS
CHAIR: ED SMITH
CO-CHAIR: HANS WEICHERT

15.1 **The Effect of Running Speed of High Speed Trains on the Surface Erosion of Pantograph Strip under Pantograph Arc**
Guoqiang Gao, Pan Xu, Wenfu Wei, Zefeng Yang, Guangning Wu, Southwest Jiaotong University

15.2 **Characteristics of Sliding Electric Contact between Couples of Carbon and Metal Materials**
Wenfu Wei, Zefeng Yang, Guangning Wu, Southwest Jiaotong University

15.3 **Characterization of Nanocomposite Graphene/Polymer Films for Electrical Contact Applications**
Yoan Bourlier[1], Sophie Noel[1], Pascal Viel[2], Aurore Brérzard-Oudot[1], Pascal Chrétien[1], Anthony Franchini[3], Antoine Fares Karam[3], [1]Université Paris-Sud, [2]Centre d'Etudes de Saclay, [3]Amphenol-ICC

9:00AM – 9:20AM
BREAK

9:20AM – 10:45AM
TESTING
CHAIR: GEORGE FLOWERS
CO-CHAIR: SIEGFRIED FOUVRY

16.1 **Evaluation of Degradation Degree of Plated Base Metal Contacts by Impedance Measurement**
Yasuhiro Fukuyama[1], Jun Toyoizumi[2], Yoshitaka Itou[2], Takaya Kondo[2], Nobu-Hisa Kaneko[1] [1]National Institute of Advanced Industrial Science and Technology, [2]Yazaki Parts Co., Ltd.

16.2 **Investigation on the Thermal Failure Evaluation of Load-Sharing Connectors**
Ruoyu Wang, Liangjun Xu, Yilin Zhou, Beijing University of Posts and Telecommunications

16.3 **Accelerated Testing of Electromechanical Connectors Considering Thermal and Mechanical Loads**
Jian Song, Haomiao Yuan, Christian Koch, Ostwestfalen-Lippe University of Applied Sciences

16.4 **Pitfalls in Environmental Endurance Testing of Electrical Connectors – Problem Overview and Discussion**
Lena Sjögren[1], Tag Hammam[1], Åsa Kassman Rudolphi[2], [1]Swerea KIMAB, [2]Uppsala University

10:45AM –11:10AM
BREAK

11:10AM – 12:10PM
RELAYS
CHAIR: GERALD WITTER
CO-CHAIR: MAKOTO HASEGAWA

17.1 **Study on Conducted Electromagnetic Interference of DC SSR Based on Synthesizing Modeling Method**
Le Xu[1], Sanqiang Ling[1], Qiang Li[2], Xueyong Chen[3], [1]Harbin Institute of Technology, [2]China Academy of Launch Vehicle Technology, [3]Avic Jonhon Optronic Technology Co., Ltd.

17.2 **Overload Capacity Experimental Research and the Improved Design Method for the Contact System of an SSER**
Bo Li[1], Yang Wu[2], LingLing Pan[3], Jiaxin You[2], Xu Tan[4], Huimin Liang[2] [1]China Telecom Co. Ltd, [2]Harbin Institute of Technology, [3]Nanjing University of Science and Technology, [4]ShaanXi QunLi Electric Co. Ltd.

17.3 **A Study on Growth of Dust of Needle-Like Crystal from a Flame Retarder of Electromagnetic Relay Housing**
Kazuaki Miyanaga, Satoshi Matsumoto, Katsuyuki Takahashi, Shailendra Kumar Shah, Fumio Takei, Akihiko Nakamura, Yoshinori Kurata, Fujitsu Component Limited

12:10PM – 1:10PM
Lunch (on your own)

1:10PM – 2:30PM
ARCING III
CHAIR: PAUL SLADE
CO-CHAIR: VOLKER BEHRENS

18.1 **Breaking Performance of a Novel DC Contactor Concept**
Erik Johansson, Anna Andersson, Gunnar Johansson, Mats Johansson, ABB AB

18.2 **An Experimental Investigation of Dynamic Welding Mechanism of Contacts Used in Low Current Switching Devices**
Xu Zhang[1], Zhe Zheng[1], Wanbin Ren[1], Zhefeng Zhou[2] [1]Harbin Institute of Technology, [2]G&A Electronics Ltd. Co.

18.3 **Simulation of Electrode Erosion under DC Air Arc**
Yunkun Deng[1], Yi Ma[2], Dada Wang[2], Yihong Wu[3], Xiaofeng Deng[3], Guobin Hou[3], Xingwen Li[3] [1]Yunnan Power Grid Corp, [2]Yunnan Electric Power Grid Research Institute, [3]Xi'an Jiaotong University

18.4 **Partial Discharges in Low Voltage Switchgears at Elevated Temperatures**
Karsten Fuchs[1], Frank Berger[1], Heribert Schorn[2]
[1]Technische Universität Ilmenau, [2]Institute for International Product Safety GmbH

18.5 **Internal Arc Fault Simulation in Medium Voltage Panel for Thermal and Structural Withstand**
Parkash Kumar, Amol Kale, Abhimanyu Kumar Singh, Mahesh Ranade, Larsen & Toubro Ltd.

2:50PM
CLOSING REMARKS
ROD MARTENS

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