

# **2006 IEEE Conference on Electrical Insulation and Dielectric Phenomena**

**Kansas City, Missouri  
15-18 October 2006**

**Volume 1 of 2**



**IEEE Catalog Number:**  
**ISBN:**

**06CH37829**  
**1-4244-0546-7**

**Copyright © 2006 by The Institute of Electrical and Electronics Engineers, Inc.  
All Rights Reserved**

*Copyright and Reprint Permissions:* Abstracting is permitted with credit to the source. Libraries are permitted to photocopy beyond the limit of U.S. copyright law for private use of patrons those articles in this volume that carry a code at the bottom of the first page, provided the per-copy fee indicated in the code is paid through Copyright Clearance Center, 222 Rosewood Drive, Danvers, MA 01923.

For other copying, reprint or republications permission, write to IEEE Copyrights Manager, IEEE Operations Center, 445 Hoes Lane, Piscataway, New Jersey USA 08854. All rights reserved.

IEEE Catalog Number:                   06CH37829  
ISBN:                                       1-4244-0546-7  
LOC:                                        79649806

**Additional Copies of This Publication Are Available from:**

IEEE Service Center  
445 Hoes Lane  
Piscataway, NJ 08854  
IEEE Service Center  
445 Hoes Lane  
Piscataway, NJ 08854  
Phone:           (800) 678-IEEE  
                  (732) 981-1393  
Fax:             (732) 981-9667  
E-mail:         customer-service@ieee.org

# Table of Contents

## The Whithead Lecture

Behavior of Charge Carriers in Organic Insulating Materials <i>Teruyoshi Mizutani</i> .....	1
--	---

## Session 1 General I

1-1	Characterization of XLPE MV-Size DC Cables by Means of Space Charge Measurements <i>Riccardo Bodega, Peter H.F. Morshuis, Edwin J.D. Straathof, Ulf H. Nilsson, and Gabriele Perego</i> .....	11
1-2	Effect of Crystallinity on Electrical Conduction Characteristics of Poly-L-lactic Acid <i>Fukutaro Kato, Shingo Omori, Makoto Matsushita, and Yoshimichi Ohki</i> .....	15
1-3	Dielectric Properties of Boron Nitride Filled Epoxy Composites <i>Chao Zhang and Gary C. Stevens</i> .....	19
1-4	Behavior Modeling of a $\text{CaCu}_3\text{Ti}_4\text{O}_{12}$ Ceramic for Capacitor Applications <i>Axel Rumeau, P. Bidan, T. Lebey, L. Marchin, B. Barbier, and S. Guillemet</i> .....	23
1-5	Optimized Charge Simulation Models of Horizontal Sphere Gaps <i>N.K. Kishore, Gururaj S. Punekar, and H.S.Y. Shastry</i> .....	27
1-6	Some Mechanistic Understanding of the Impulse Strength of Nanocomposites <i>Yujie Hu, Robert C. Smith, J. Keith Nelson, and Linda S. Schadler</i> .....	31

## Session 2A Measurement Techniques

2A-1	Development of a Digital Algorithm Based on Instantaneous Power Transform for On-Line Monitoring of the Dielectric Loss Factor <i>Wang Guan and Li Qing-min</i> .....	35
2A-2	On-Site Testing of Instrument Transformers <i>Carlos G. Azcarraga, V. Rodolfo Garcia-Colon, and Armando Nava G.</i> .....	39
2A-3	Dielectric Response Measurements Utilizing Non-Sinusoidal Waveforms <i>Björn Sonnerud, Tord Bengtsson, Jörgen Blennow, and Stanislaw M. Gubanski</i> .....	43
2A-4	On-Line Time Domain Reflectometry Measurements of Temperature Variations of an XLPE Power Cable <i>Valentinas Dubickas, and Hans Edin</i> .....	47
2A-5	Research on Propulsion Effect of Exploding Wire in Water <i>Zhang Chunxi and Yang Jiaxiang</i> .....	51

2A-6	Change in Heat Resistive, Electrical Insulating and Mechanical Properties of Hybrid Made with PDMS and TEOS for the Mole Ratio of Them <i>Tetsushi Okamoto, Takuya Shindou, Makoto Sugiura, and Shuhei Nakamura</i> .....	55
2A-7	Multiphysics Simulation to Improve the Understanding of Pressure Wave Propagation Techniques Applied to Composite Polymers <i>Olivier Gallot-lavallée, Jean-Luc Reboud, and Pascal Rain</i> .....	61
2A-8	Chemical and Physical Changes Observed in Poly(Oxy-1,4 Phenylsulfonyl-1,4 Phenylene) Following Electrical Stressing <i>M. Uttamlal, Sebastien Falcoz, A. Sheila Holmes-Smith, Donald M. Hepburn, Brian G. Stewart, and Richard A. Fouracre</i> .....	65
2A-9	Space Charge in XLPE Near the Electrode Interfaces <i>Robert J. Fleming, S.B. Lang, and Tadeusz Pawlowski</i> .....	69
2A-10	Oil Reclamation – Just a Question of Moisture? <i>Peter M. Mitchinson, Paul L. Lewin, Ian L. Hosier, George Chen, and Paul N. Jarman</i> .....	73
2A-11	Optimal Wavelet Selection to Identify Faults During Impulse Tests <i>S.N. Fernando, M.R. Raghuvver, and W. Ziomek</i> .....	77
2A-12	Effects of Moisture on Power Factor of Oil/Paper Insulation <i>Khaled Abdolall and A. John Vandermaar</i> .....	81
2A-13	HF/Microwave Impedance of Carbon Nanotube Films <i>Xianming Liu, Amanda V. Ellis, and W. Mike Arnold</i> .....	89
2A-14	Use of Wavelet and Neural Network (BPFN) for Transformer Fault Diagnosis <i>Ch. Prasanth Babu, M. Surya Kalavathi, and B.P. Singh</i> .....	93
2A-15	High Temperature Dielectric Behavior of Al/Polyimide/Al Capacitor Structures <i>Sombel Diaham, M.L. Locatelli, and T. Lebey</i> .....	97
2A-16	A Fully Self-Consistent Parametric 2D Model of the Filamentary Streamer Head as Applied to Spectral Diagnostics of Streamer Discharges <i>Yuri V. Shcherbakov</i> .....	101
2A-17	An Analysis of Highly Synchronized and Space-and-Time Resolved Nitrogen FNS and SPS Emission Temporal Waveforms Produced by the Repetitive DC Streamer Corona <i>Yuri V. Shcherbakov, and Leonid I. Nekhamkin</i> .....	105
2A-18	Understanding of Electrical Treeing in PMMA by Partial Discharges and Thermally Stimulated Discharges <i>P. Basappa and J. Kim</i> .....	109
2A-19	Assessment of Drying Quality for Power Transformers During Manufacturing Process Using Variation of Transfer Function <i>Asghar Akbari, H. Firoozi, H. Borsi, and M. Kharezi</i> .....	113

2A-20	Electrical Properties of a Commercial Resin <i>Enis Tuncer, Isidor Sauers, D. Randy James, and Alvin R. Ellis</i> ..... 117
2A-21	Lightning Impulse Behavior of Conducting Composite Electrodes <i>Magne Runde, O. Lillevik, P. Roseen, O. Granhaug, R. Espeseth, and P. Skryten</i> ..... 121

## Session 2B Charge Storage and Transport

2B-1	Relation Between Space Charge and Pore Size of Nano Porous Electrode for Super Capacitor <i>Daisuke Tashima, Kenji Kurosawatsu, Masahisa Otsubo, and Chikahisa Honda</i> ..... 125
2B-2	Finite Element Analysis of Charge Injection and Transport in a Dielectric Liquid <i>Se-Hee Lee, Francis O'Sullivan, Il-Han Park, Markus Zahn, Leif Pettersson, Rongsheng Liu, Olof Hjortstam, Albert Jaksts, Tommaso Auletta, and Uno Gäfvert</i> ..... 129
2B-3	Effect of Antioxidants on Space Charge Generation in Cross-Linked Polyethylene and EPR <i>Yasuo Sekii, Atsushi Taya, and Takashi Maeno</i> ..... 133
2B-4	Observation of Charge Distribution in Electron Beam Irradiated Polymers Using Pulsed Electro-Acoustic Method <i>Wei Dang, Mai Tahara, Junya Taima, Yasuhiro Tanaka, R. Watanabe, and Tatsuo Takada</i> ..... 138
2B-5	Electron Irradiation Effects on Polymeric Films Studied by the Pulsed Electro-Acoustic Method <i>Virginie Griseri, Charlotte Perrin, Kaori Fukunaga, Takashi Maeno, Bernard Dirrassen, D. Payan, and Christian Laurent</i> ..... 142
2B-6	Piezoelectricity of a Single Bubble Formed by Two Oppositely Charged Teflon® -FEP Films <i>Heitor Cury Basso, Cláudio Vara de Aquino, Ruy Alberto Pisani-Altafim, Ruy Alberto Corrêa Altafim, and Reimund Gerhard-Multhaupt</i> ..... 146
2B-7	Change in Electroluminescence Activity in Polymers Prior to AC Dielectric Breakdown <i>D. Mary and D. Malec</i> ..... 150
2B-8	Modeling and Measurements of Electric Fields in Composite Oil/Cellulose Insulation <i>Uno Gäfvert, Olof Hjortstam, Yuriy Serdyuk, Christer Törnkvist, and Lars Walfridsson</i> ..... 154
2B-9	Thermal Wave Probing: Polynomial and Regularized Solutions with L-Curve <i>Tadeusz Pawlowski, and Robert J. Fleming</i> ..... 158

2B-10	Study on the Characteristics of Jatropha and Ricinus Seed Oils as Liquid Insulating Materials <i>Suwarno M. Ilyas</i> .....	162
-------	--	-----

## Session 2C Electrohydrodynamics and High Field Effects

2C-1	Experimental Study of Electrohydrodynamic Pumping Feasibility in Microgravity Condition through Conduction Phenomenon <i>Mehdi Ashjaee and Seyed Reza Mahmoudi</i> .....	166
2C-2	An Experimental Study on NOx Treatment in Diesel Engine Combustion Exhaust Gases by Ozone Injection and Absorption Processes <i>Shinsuke Kikuchi and Ryu-ichiro Ohyama</i> .....	170
2C-3	Optical Characterization of Ionic Wind Field by Means of Laser-Induced Phosphorescence <i>Kentaro Aoyagi, Yu Kitahara, and Ryu-ichiro Ohyama</i> .....	174
2C-4	An Experimental Evaluation on Ozone Generation by Local Discharge Type Gas Jets <i>Tetsuya Shiotsuka and Ryu-ichiro Ohyama</i> .....	178
2C-5	Polarity Effect and Flow Characteristics of Wire-Rod Type Electrohydrodynamic Gas Pump <i>Behrooz Komeili, Jen-Shih Chang, and Glenn Harvel</i> .....	182
2C-6	Derivation of the Korteweg-Helmholtz Electric and Magnetic Force Densities Including Electrostriction and Magnetostriction from the Quasistatic Poynting's Theorems <i>Markus Zahn</i> .....	186
2C-7	Model for Comprehensive Simulation of Overhead High Voltage Power Transmission Line Galloping and Protection <i>Jicai Hu, Z. Song, Jianguo Ma, and Shijing Wu</i> .....	190
2C-8	Linear Stability of an Interface Between a Non-Ohmic Liquid and Air Subjected to an Electric Field and Charge Injection <i>Rafael Chicón and Alberto T. Pérez</i> .....	194
2C-9	Dielectric Properties of Insulating Materials for Printed Circuit Boards at mm-Waves <i>Masaki Kouzai, Tomohiro Ogiwara, Atsuhiko Nishikata, and Kaori Fukunaga</i> .....	198
2C-10	Dynamic Characteristics of High Field Electro-Active Silicone and Acrylic Elastomer Actuator Devices <i>Toshikatsu Tanaka, Kenta Saeki, and Kenji Matsuki</i> .....	202
2C-11	The Influence of Sag in the Electric Field Calculation Around High Voltage Overhead Transmission Lines <i>Amiri Rabie, Hadi Hocine, and Mohamed Marich</i> .....	206

2C-12	Film Thickness Dependence of Dissipation Current for LDPE Film under Trapezoid Waveform Application <i>Shingo Tsuboi, Kazuyuki Tohyama, and Masayuki Nagao</i> .....	210
2C-13	Minimization of Local Field Enhancement Along Stress-Grading Systems of HV Large Rotating Machines <i>Hassan El-Kishky, Robert Hebner, Mazen Abdel-Salam, and Fredericka Brown</i> .....	214
2C-14	Higher Frequency Performance of Stress-Grading Systems for HV Large Rotating Machines <i>Robert Hebner, Hassan El-Kishky, Mazen Abdel-Salam, and Fredericka Brown</i> .....	218

### Session 3A Prebreakdown and Breakdown in Solids, Liquids, Gases, and Vacuum

3A-1	Prediction of Breakdown Voltages in N <sub>2</sub> + SF <sub>6</sub> Gas Mixtures <i>S.S. Tezcan, M.S. Dincer, and H.R. Hiziroglu</i> .....	222
3A-2	Investigation on the High Frequency, High Voltage Insulation Properties of Mineral Transformer-Oil <i>Mischa Nagel and Thomas Leibfried</i> .....	226
3A-3	Surge Voltage Stresses Across Power Transformer Winding Sections Provided with Metal Oxide Surge Absorber Blocks <i>G.R. Gurumurthy, Mohd. Z.A. Ansari, J. Amarnath, and N.K. Kishore</i> .....	229
3A-4	Impulsive Strength of Power Cables with Different XLPE Compounds <i>Massimo Marzinotto, Carlo Mazzetti, Massimo Pompili, and Prospero Schiaffino</i> .....	233
3A-5	Effect of Moisture Diffusion and Heat Cycling on Low Voltage Oil-Impregnated-Paper Insulated Distribution Cables <i>Simon M. Rowland, Miao Wang, and Mattieu Michel</i> .....	237
3A-6	Effect of Endothermic Reaction Associated with Glass Transition on the Breakdown Strength of Biodegradable Polymer Films <i>Fukutaro Kato, Makoto Matsushita, Shingo Omori, and Yoshimichi Ohki</i> .....	241
3A-7	Numerical Modeling of Negative Corona Discharge in Dry Air: The Role of Carbon Dioxide <i>Agustín Fernández-Rueda, Francisco Pontiga, and Antonio Castellanos</i> .....	245
3A-8	A Linear Model for the Differences of Breakdown Voltages in IEC 60052 Tables <i>Vuttichai Chatpattananan and N. Pattanadech</i> .....	249
3A-9	An Asymptotic Regression Predictive Model for Sphere Gap Voltage with Gap Diameter and Gap Spacing <i>Vuttichai Chatpattananan</i> .....	253
3A-10	Characteristics of the Bipolar Pulsed Discharge in the Water-Air-Solid Particle Mixture <i>Ruobing Zhang, Chi Zhang, Xingxin Cheng, Liming Wang, and Zhicheng Guan</i> .....	257

3A-11	Comparison of Electroluminescence Phenomenon in LDPE, PET and PEN under the Application of High Electrical Stress <i>Azrul Mohd Ariffin, Paul L. Lewin, and Stephen J. Dodd</i> .....	260
3A-12	Nitrogen Oxides Generation Induced by Negative Corona Discharge in N <sub>2</sub> + O <sub>2</sub> Mixtures <i>Francisco Pontiga and Antonio Castellanos</i> .....	264
3A-13	Correlation of Partial Discharge and Dissolved Gas Analysis Results from Discharge Activity in SRBP <i>Matthew A. Brown, Stephen J. Dodd, Barry Ahern, John Pettinger, and Francis Waite</i> .....	268
3A-14	Polar/non-Polar Polymer Blends: On Structural Evolution and the Electrical Properties of Blends of Polyethylene and Ethylene - Vinyl Acetate <i>Alun S. Vaughan, Gabriele Gherbaz, Steven G. Swingler, and Norainah Abd Rashid</i> .....	272
3A-15	Determination of Particle Movement of Conducting Particles in SF <sub>6</sub> /N <sub>2</sub> Mixture GIL Using Monte Carlo Simulation <i>Poonam Upadhyay, Jinka Amarnath, B.P. Singh, and Pravin Upadhyay</i> .....	276
3A-16	Movement of Metallic Particles in Gas Insulated Line Using SF <sub>6</sub> and N <sub>2</sub> Gas Mixture Under the Influence of Power Frequency and Switching Transient Voltage <i>Poonam Upadhyay, Jinka Amarnath, B.P. Singh, and Pravin Upadhyay</i> .....	280
3A-17	Analysis on Plasma Chemistry in Corona Discharge Process for NO Removal Using Numerical Simulations Method <i>Dong Limin and Wang Peng</i> .....	284
3A-18	Pre-Ionization Methods for Atmospheric Pressure Discharge Controlled by Dielectric Barrier <i>Zhan Huamao, Ding Lijian, Li Chengrong, and Li Ming</i> .....	287
3A-19	Numerical Characterization of Electrical Stresses on Dielectric Grease of Rolling Bearings in Induction Motors Fed by PWM Inverters <i>Carlo Petrarca, Giovanni Lupò, Biagio De Vivo, Luigi Egiziano, and Vincenzo Tucci</i> .....	290

### Session 3B Nanodielectrics

3B-1	Electrical Tree Growth in EVA-Layered Silicate Nanocomposites <i>Francesco Guastavino, Andrea Dardano, Gian Carlo Montanari, Fabio Deorsola, and Luigi Testa</i> .....	294
3B-2	Interpretation of Several Key Phenomena Peculiar to Nano Dielectrics in Terms of a Multi-Core Model <i>Toshikatsu Tanaka</i> .....	298



3B-3	Observation of Space Charge Formation in LDPE/MgO Nano-Composite Under DC Stress at High Temperature <i>Junya Taima, Kensuke Inaoka, Takuya Maezawa, Yasuhiro Tanaka, Tatsuo Takada, and Yoshinao Murata, .....</i>	302
3B-4	Comparison of Insulation Breakdown Properties of Epoxy Nanocomposites under Homogeneous and Divergent Electric Fields <i>Takahiro Imai, Fumio Sawa, Tamon Ozaki, Yoshiyuki Inoue, Toshio Shimizu, and Toshikatsu Tanaka.....</i>	306
3B-5	Thermal Properties of LDPE/Silica Nanocomposites <i>Zhi-dong Han, Changjun Diao, Ying Li, and Hong Zhao .....</i>	310
3B-6	Dielectric Properties of LDPE/MgO Nanocomposite Material Under AC High Field <i>Kensuke Hinata, Ayano Fujita, Kazuyuki Tohyama, and Yoshinao Murata .....</i>	313
3B-7	Electrical Properties of Carbon Nanotubes – Syndiotactic Polypropylene Composites <i>Paolo Ciambelli, Biagio De Vivo, Giuliana Gorrasi, Valentina Romeo, Diana Sannino, M. Sarno, Vincenzo Tucci, and Vittoria Vittoria .....</i>	317
3B-8	Influence of Absorbed Water on the Dielectric Properties and Glass-Transition Temperature of Silica-Filled Epoxy Nanocomposites <i>C. Zou, M. Fu, J.C. Fothergill, and S.W. Rowe.....</i>	321
3B-9	Dielectric Properties of Epoxy-Alumina Nanocomposites: The Effect of Absorbed Water <i>Chao Zhang and Gary C. Stevens .....</i>	325
3B-10	AC Electrical Strength Measurements on LDPE Nanocomposites <i>Francesco Guastavino, Alessandro Ratto, Eugenia Torello, Mario Hoyos, Nuria García, H. Reinecke, Esperanza Benito, and Pilar Tiemblo .....</i>	329
3B-11	On Molecular Dielectrics in Their Role in Shaping and Controlling Nanodielectrics <i>Michel F. Fréchette and Clive W. Reed.....</i>	333
3B-12	Preliminary Characterization of a Nanodielectric Material <i>Serge Pélassou, Simon Besner, Michel Fréchette, K.C. Cole, and Dominique Desgagnés.....</i>	338
3B-13	On the Degree of Exfoliation Affecting the Corona Performance of a Nanodielectric Surface <i>Michel Fréchette, R.Y. Larocque, M. Lessard, M.L. Trudeau, R. Veillette, K.C. Cole, and M.-T. Ton That.....</i>	341
3B-14	Electrical Properties Analysis of Nano-Filled Epoxy by Space Charge Characterization <i>J. Castellon, S. Agnel, A. Toureille, Michel F. Fréchette, K.C. Cole, and Dominique Desgagnés.....</i>	345

3B-15	Studies of TiO <sub>2</sub> Breakdown Under Pulsed Conditions <i>Guogang Zhao, Ravindra P. Joshi, Vishnu K. Lakdawala, E. Schamiloglu, and H. Hjalmarson</i> .....	349
-------	---	-----

## Session 4 General II

4-1	Electroporation - How Different Length and Shaped Electrical Pulses Affect the Permeability of Cells <i>Keith Daly and George Chen</i> .....	353
4-2	Electrical Properties of Biological Tissues - An Impedance Spectroscopy Study <i>David A. Dean, David Machado-Aranda, Thilliyar Ramanathan, Ignacio Molina, and Raji Sundararajan</i> .....	357
4-3	Calculation of Electrical Fields in Electrical Tree Channels <i>Prathap Basappa and Jaehwan Kim</i> .....	361
4-4	Field Trials of 400 kV Silicone Rubber Composite Insulators in a Coastal Location <i>Jeffry Robertson, Simon M. Rowland, Yu Xiong, and Sven Hoffmann</i> .....	365
4-5	A Theoretical Investigation for the Development of a Water Tree Dielectric Response Model <i>Andrew J. Thomas and Tapan K. Saha</i> .....	369
4-6	Some Fundamentals on Treeing Breakdown in Inorganic-Filler/LDPE Nano-Composite Material <i>Rudi Kurnianto, Yoshinobu Murakami, Naohiro Hozumi, Masayuki Nagao, and Yoshinao Murata</i> .....	373

## Session 5A Outdoor Insulation

5A-1	Mechanism Analysis on Hydrophobicity Decrease of Operating Silicone Rubber Insulators <i>Xingquan Huang, Linjie Zhao, Chengrong Li, Shuqi Zhang, Jisha Yao, Jun Xiong, and Wei Song</i> .....	377
5A-2	An Outdoor Investigation on Hydrophobicity of Silicone Rubber Insulators in the Temperature Zone <i>Linjie Zhao, Chengrong Li, Jisha Yao, Shuqi Zhang, Jun Xiong, Guang Xu, and Weidong Zhang</i> .....	381
5A-3	A Novel Method for Prediction of Flashover of In-Service EPDM Insulators <i>Sreeram Venkataraman and Ravi S. Gorur</i> .....	385
5A-4	Chemical Analysis of Outdoor Silicone Materials After Electrical and Environmental Testing <i>Andrej Krivda, F. Greuter, J. Rocks, X. Kornmann, and P. Meier</i> .....	389
5A-5	Properties of Corona Discharge Under Positive DC Voltage at Low Atmospheric Pressure <i>Defen Yu, Masoud Farzaneh, J. Zhang, L. Shu, Wenxia Sima, and Caixin Sun</i> .....	393

5A-6	Distribution of Leakage Current on Polluted Polymer Insulator Surface <i>Yong Zhu, Kenichi Haji, Hirofumi Yamamoto, Takuma Miyake, Masahisa Otsubo, and Chikahisa Honda</i> .....	397
5A-7	Determination of Long-Term Performance of Polymeric Insulators for Distribution Lines by Salt Fog Method <i>Hiroya Homma, Takeshi Takahashi, Toshiyuki Kuroyagi, Yoshiharu Miyauchi, Naoya Matsuno, Takehiko Saito, Kenjiro Mori, S. Matsuura, Kouji Fujii, Akinori Ohno, and Naoya Ahagon</i> .....	401
5A-8	Damage Threshold of Polymeric Housing Materials Used for Outdoor HV Insulators <i>Balesubramanian N. Pinnangudi, Ravi S. Gorur, and Christian D. Poweleit</i> .....	405
5A-9	A Comparative Study of the Impact of Moisture on the Dielectric Capability of Esters for Large Power Transformers <i>Daniel Martin and Z.D. Wang</i> .....	409
5A-10	Condition Assessment of Porcelain and Toughened Glass Insulators from Residual Strength Tests <i>Ankit P. Mishra, Ravi S. Gorur, Sreeram Venkataraman, and D. Kingsbury</i> .....	413
5A-11	Characterisation of Field-Aged 400 kV Silicone Rubber Composite Insulators <i>Yu Xiong, Simon M. Rowland, Jeffry Robertson, and Sven Hoffmann</i> .....	417
5A-12	Nonlinear Electrical Behavior of Treated ZnO-EPDM Nanocomposites <i>Xiaoping Wang, S. Herth, T. Hugener, R.W. Siegel, J. Keith Nelson, Linda S. Schadler, H. Hillborg, and Tommaso Auletta</i> .....	421
5A-13	Lightning Current and Flashover Path Measurement on High Voltage Transmission Lines <i>Yangchun Cheng, Chengrong Li, and Fei Zhang</i> .....	425
5A-14	Dynamics Characteristic of V-String Composite Insulators for 330kV Overhead Transmission Line <i>Lei Hou, Liming Wang, and Zhicheng Guan</i> .....	429
5A-15	Surface Static Properties of Plasma Treated FRP <i>Jong Kwan Park, Claire Gu, and Beak-Su Lee</i> .....	433
5A-16	Arc Characteristics of Polluted Insulators Covered with Ice <i>Yadollah Sabri, Masoud Farzaneh, and J. Zhang</i> .....	437
5A-17	New Approach for the Modeling of the Polluted Insulators <i>Mohamed Marich, Hocine Hadi, and Rabie Amiri</i> .....	441
5A-18	Diagnosis of Degradation Condition of Polymer Material Using Hydrophobic Surface Analysis <i>Tetsuro Tokoro, Satoshi Yanagihara, and Masayuki Nagao</i> .....	445

5A-19	Influence of Angles of V-Strings on DC Flashover Characteristics of Polluted Insulators in High Altitude Areas <i>Zhang Fuzeng, Wang Xin, Long Biao, Wang Liming, Guan Zhicheng</i> .....	449
5A-20	Dielectric Spectroscopy in Silicone Rubber Incorporating Nanofiller <i>N. Andrés Pérez, Alain Sylvestre, Jean-Louis Augé, Minh Tuan Do, and S.W. Rowe</i> .....	453
5A-21	Corona Ring Design of $\pm 800$ kV DC Composite Insulator Based on Computer Analysis <i>Wenxia Sima, Kun Wu, Qing Yang, and Caixin Sun</i> .....	457
5A-22	Characterization of Aging and Degradation of 28kV Polymeric Insulators Using Electrical Impedance Spectroscopy <i>Raji Sundararajan, A.M. Kannan, Edwin Romero, and Ignacio Molina</i> .....	461
<b>Session 5B Aging</b>		
5B-1	Evaluation of Medium Voltage Stator Bar Groundwall Insulation Under Inverter-Fed Pulses <i>Saeed Ul-Haq, Shesha H. Jayaram, and Edward A. Cherney</i> .....	465
5B-2	Statistical Analysis of in Service Failed Epoxy Resin Bushings in a 50 kV Switchgear Assembly <i>Rogier A. Jongen, Peter H.F. Morshuis, Johan J. Smit, Anton L.J. Janssen, and Edward Gulski</i> .....	469
5B-3	Deterioration Diagnosis of Insulators for Breakers Using Chemical Evaluation and Mahalanobis-Taguchi (MT) Method <i>Shinsuke Miki and Hiroshi Okazawa</i> .....	473
5B-4	Improved Condition Assessment of XLPE Insulated Cables Using the Isothermal Relaxation Current Technique <i>Bolarin S. Oyegoke</i> .....	477
5B-5	Ageing of Biodegradable Oils for High Voltage Insulation Systems <i>Ian L. Hosier, Alun S. Vaughan, and Francis A. Montjen</i> .....	481
5B-6	The Release of Volatiles During the Thermal Stress of Electric Insulating Materials <i>Václav Mentlík, Radek Polanský, and Pavel Prosr</i> .....	485
5B-7	Effects of X-Ray Radiation on Solid Insulating Materials <i>S. Sudalaimuthu, M. Joy Thomas, S. Senthil Kumar, and V. Vinod Kumar</i> .....	489
5B-8	A Comparative Study of the Chemical Stability of Esters for Use in Large Power Transformers <i>Daniel Martin, Z.D. Wang, A.W. Darwin, and I. James</i> .....	493
5B-9	Effect of Ageing on the Impulse Breakdown Strength of Oil-Impregnated Pressboard Used in Power Transformers <i>Hongzhi Ding, Z.D. Wang, and Paul N. Jarman</i> .....	497

5B-10	Mechanical and Electrical Issues Concerning the Use of Composite Materials for the Supporting Core in Transmission Line Conductors <i>Ravi S. Gorur, N. Chawla, James Hunt, and Mike Dyer</i> .....	501
5B-11	Kinetic Analysis and Modeling of Ageing Process for Kraft Paper Aged in Natural Ester Dielectric Fluid <i>Hongzhi Z. Ding and Z.D. Wang</i> .....	505
5B-12	A Method to Detect the Deterioration of HTV Silicone Rubber Under Corona Discharge <i>Ying Liang, Lijian Ding, C.R. Li, Kun Yang, and Youping Tu</i> .....	509
5B-13	Towards Water-Resistant High Voltage Insulation Systems: An Ageing Study of a Technological Water-Blocking Polymer <i>Laurent L. Barre, Alun S. Vaughan, and Simon J. Sutton</i> .....	513
5B-14	Failure Analysis of in Service Failed Resin Cable Joints by Means of a Statistical Approach <i>Rogier A. Jongen, Peter H.F. Morshuis, Johan J. Smit, Anton L.J. Janssen, and Edward Gulski</i> .....	517
5B-15	Diagnosis of Electrical and Mechanical Faults of Induction Motor <i>Hisahide Nakamura, Yousuke Yamamoto, and Yukio Mizuno</i> .....	521
5B-16	Characteristics of Current Flowing on Plug Under Contaminated and Wetted Condition <i>Masahiro Yagi, Ken-ichi Okabe, Yukio Mizuno, and Toshiyuki Nakagawa</i> .....	525
5B-17	Dissipation Current Waveform of Water Tree Deteriorated Low Density Polyethylene Sheet <i>Takamasa Furuhashi, Kazuyuki Tohyama, Tomoaki Imai, and Yoshinao Murata</i> .....	529
5B-18	State Estimation of Accelerated Aged Mineral Filled Epoxy Insulating Materials <i>Michael Budde, Frank Gerdinand, and Michael Kurrat</i> .....	533
5B-19	Space Charge Evolution in XLPE with Long-Term Aging Under DC Voltage - The Effect of Temperature and Polarity Reversals <i>Mahmoud Abou-Dakka, A.T. Bulinski, and Soli Bamji</i> .....	537
5B-20	Dielectric Losses and Breakdown in Silicone Gel <i>Minh Tuan Do, Jean-Louis Augé, and Olivier Lesaint</i> .....	541
5B-21	Analyzing Dynamic of Moisture Equilibrium in Oil-Paper Insulation in Power Transformers for Efficient Drying <i>Asghar Akbari, S. DehPahlevan, and H. Borsi</i> .....	545
5B-22	Dielectric Response of Rotating Machine Stator Insulation System <i>Laurent Lamarre and Eric David</i> .....	549

5B-23	Accelerated Acid-Water Aging of RTV Silicone Rubber Coatings <i>Ali Naderian Jahromi, Edward A. Cherney, Shesha H. Jayaram, and Leonardo C. Simon</i> .....	553
-------	--	-----

### Session 6 General III

6-1	Polymer Composite/Nanocomposite Processing and Its Effect on the Electrical Properties <i>Santanu Singha and M. Joy Thomas</i> .....	557
6-2	Breakdown Statistics of Polyimide at Low Temperatures <i>Enis Tuncer, Isidor Sauers, D. Randy James, Alvin R. Ellis, and Marshall O. Pace</i> .....	561
6-3	Partial Discharge Propagation and Degradation Characteristics of Magnet Wire for Inverter-Fed Motor under Surge Voltage Application <i>Naoki Hayakawa, Hiroshi Inano, Kenta Inuzuka, Masato Morikawa, and Hitoshi Okubo</i> .....	565
6-4	Ultrafast Gas Breakdown at Pressures Below One Atmosphere <i>Hermann Krompholz, Lynn Hatfield, Andreas Neuber, Jordan Chaparro, H.Y. Ryu, and William Justis</i> .....	569
6-5	A Classification of Partial Discharge on High Voltage Equipment with Multinomial Logistic Regression <i>Vuttichai Chatpattananan and N. Pattanadech</i> .....	573
6-6	Forecasting Transformer Reliability <i>Arjan van Schijndel, Joseph M. Wetzer, and Peter A.A.F. Wouters</i> .....	577

### Session 7A Partial Discharge Measurements

7A-1	A Study of SO <sub>2</sub> Removal by Positive Pin-Plate Discharge System <i>Dong Limin, Han Zhidong, Wu Ze, and Yang Jiaxiang</i> .....	583
7A-2	Partial Discharge Potential Free Test Methods <i>Václav Mentlík, Josef Pihera, Pavel Trnka, and Petr Martinek</i> .....	586
7A-3	Partial Discharges in Silicone Gel in the Temperature Range 20-150 C <i>Minh Tuan Do, Jean-Louis Augé, and Olivier Lesaint</i> .....	590
7A-4	Partial Discharge Characteristics of Nanocomposite Enameled Wire for Inverter-Fed Motor <i>Kenta Inuzuka, Hiroshi Inano, Naoki Hayakawa, Tatsuya Hirose, Masahiro Hamaguchi, and Hitoshi Okubo</i> .....	594
7A-5	Continuous and Pulsed X-Ray Induced Partial Discharges: Similarities and Differences <i>Guilherme Cunha da Silva, Vitoldo Swinka Filho, and Rene Robert</i> .....	598
7A-6	Effect of Cabling and Grounding Configuration on Surge Voltages in Inverter-Fed Motors <i>Kotaro Wada, Kosei Tsuji, Hirotaka Muto, and Osamu Yashiro</i> .....	602

7A-7	Simulation and Analysis of Acoustic Wave Propagation Due to Partial Discharge Activity <i>Prasanta Kundu, Nudurupati Krishna Kishore, and Avinash Kumar Sinha</i> .....	607
7A-8	Low Pressure Partial Discharge Investigation with FEM Modeling for a Twisted Pair of Insulated Conductors <i>Xin Liu</i> .....	611
7A-9	Relationship Between PD-Induced Electromagnetic Wave Measured with UHF Method and Charge Quantity Obtained by PD Current Waveform in Model GIS <i>Shinya Ohtsuka, Takashi Teshima, Satoshi Matsumoto, and Masayuki Hikita</i> .....	615
7A-10	3-D Simulation and Modelling of Acoustic Signals from Partial Discharge Activity <i>Syed Aqeel Ashraf, Brian G. Stewart, Chengke Zhou, and J. Mohd Jahabar</i> .....	619
7A-11	Extraction of PD Signals from an Electro-Optic Modulator Based PD Measurement System <i>Liwei Hao, Paul L. Lewin, and Stephen J. Dodd</i> .....	623
7A-12	Linear Discriminant Analysis for Partial Discharge Classification on High Voltage Equipment <i>Vuttichai Chatpattananan</i> .....	627
7A-13	Partial Discharges Measured at Semi-Square Voltages <i>Elisabeth Lindell, Tord Bengtsson, Jörgen Blennow, and Stanislaw M. Gubanski</i> .....	631
7A-14	Partial Discharge Measurements for a Twisted Pair of Insulated Conductors at Low Pressures - Pulse Waveform Analysis for Argon and Helium <i>Xin Liu, Donald G. Kasten, Stephen A. Sebo, Dennis F. Grosjean, and Daniel L. Schweickart</i> .....	635
7A-15	Frequency Distribution of RF Energy from PD Sources and Its Application in Combined RF and IEC60270 Measurements <i>Alistair J. Reid, Martin D. Judd, Brian G. Stewart, and Richard A. Fouracre</i> .....	640
7A-16	Wavelet Packet Denoising of Partial Discharge Data <i>Carlo Petrarca and Giovanni Lupò</i> .....	644
7A-17	Analysis of Conditions of Partial Discharges Inception and Development at Non-Sinusoidal Testing Voltages <i>Barbara Florkowska and Pawel Zydron</i> .....	648
7A-18	New Approaches in Arrival Time-Based PD Location in Transformers <i>Sacha M. Markalous and Thomas Strehl</i> .....	652
7A-19	Extraction of Partial Discharges from Noises by Use of Wavelet and Pulse-Sequence Analysis <i>Jian Li, Stanislaw Grzybowski, Lin Du, and Youyuan Wang</i> .....	656
7A-20	The Use of the Pulse Sequence Analysis to Monitor the Condition of Oil <i>Rainer Patsch, Johannes Menzel, and Djamel Benzerouk</i> .....	660

7A-21	Partial Discharge Measurements in a High Temperature Superconducting Triaxial 5-m Model Cable at Liquid Nitrogen Temperature <i>Isidor Sauers, D. Randy James, Enis Tuncer, Alvin R. Ellis, and Marshall O. Pace</i> .....	664
-------	---	-----

### Session 7B Biodielectrics and Surface Flashover

7B-1	Dielectric Properties of Biodegradable Polymers <i>Yoshimichi Ohki and Naoshi Hirai</i> .....	668
7B-2	Prediction of Physical Properties of Yeast Cell Suspensions Using Dielectric Spectroscopy <i>D.J. Currie, M.H. Lee, and R.W. Todd</i> .....	672
7B-3	Forces Acting on Biological Cells in External Electrical Fields <i>Igor V. Timoshkin, Scott J. Macgregor, Richard A. Fouracre, M.J. Given, and John G. Anderson</i> .....	676
7B-4	Electric Properties of Vegetable-Oil-Based Dielectric Liquid and Lifetime Estimation of the Oil-Paper Insulation <i>Caixin Sun, Jian Li, Xiaohu Li, and Stanislaw Grzybowski</i> .....	680
7B-5	Water Processing by High Intensity Pulsed Electric Fields <i>Fermin Espino-Cortes, Ayman H. El-Hag, Othano Adedayo, Shesha Jayaram, and W. Anderson</i> .....	684
7B-6	Modified Finite Element Method to Consider the Singularity of the Electric Field Using a Singularity Function <i>Yeon-Ho Oh, Ki-Dong Song, Hong-Kyu Kim, and Sung-Kwan Park</i> .....	688
7B-7	Frequency Characters of Leakage Current on the Surface of Outdoor Insulators in Different Relative Humidity <i>Mao Yingke, Guan Zhicheng, Wang Liming, Wang Xin, and Yue Bo</i> .....	692
7B-8	Electrical Surface Resistivity of Organic Coating Resin in Arc-Decomposed SF <sub>6</sub> Gas <i>Tadao Minagawa, Haruhiko Kohyama, Yuji Yoshitomo, Makoto Miyashita, and Eiichi Nagao</i> .....	696
7B-9	Non-Uniform Field Breakdown and Surface Flashover in Liquid Nitrogen Gaps for HTS Applications <i>D. Randy James, Isidor Sauers, Enis Tuncer, Alvin R. Ellis, Kasegn Tekletsadik, and D.W. Hazelton</i> .....	700

### Session 7C Treeing and Polarization Phenomena

7C-1	Water Migration in Degraded XLPE Cables <i>Bolarin S. Oyegoke, David Bitrwhistle, Jim Lyall, and Tapan K. Saha</i> .....	704
7C-2	Dielectric Relaxation Study in Tantalum Pentoxide Capacitors <i>Jean-Philippe Manceau, Sylvie Bruyere, Simon Jeannot, Alain Sylvestre, and Patrice Gonon</i> .....	708



7C-3	Influence of Vacuum Evacuation on Electrical Tree Initiation in Silicone Rubber <i>Yoshihisa Kamiya, Yuji Muramoto, and Noriyuki Shimizu</i> .....	712
7C-4	Electroluminescence Properties under Long Time Voltage Application in XLPE <i>Takamori Mito, Motoo Watanabe, Yuji Muramoto, and Noriyuki Shimizu</i> .....	716
7C-5	Influence of Water-Tree Degradation on Electroluminescence Spectrum in XLPE <i>Motoo Watanabe, Takamori Mito, Yuji Muramoto, and Noriyuki Shimizu</i> .....	720
7C-6	Life Prediction of XLPE Subjected to Distorted Voltages in Presence of Bush-Like Electrical Treeing <i>Francesco Guastavino, Gianfranco Coletti, Andrea Dardano, Alessandro Ratto, and Eugenia Torello</i> .....	724
7C-7	Impact of the Polymerization Process on the Electrical Behavior of Different Impregnation Varnishes <i>Fabrice Aymonino, T. Lebey, D. Malec, C. Petit, J. Saint Michel, and A. Anton</i> .....	728
7C-8	The Use of Cable System Models for the Assessment of Space Charge Behaviour in Full-Size DC Cable Systems <i>Riccardo Bodega, P.H.F. Morshuis, Gian Carlo Montanari, Davide Fabiani, and J.J. Smit</i> .....	732
7C-9	Dielectric Response of SRBP as a Function of Oil and Oil/Moisture Absorption <i>Matthew A. Brown, Stephen J. Dodd, Barry Ahern, John Pettinger, and Francis Waite</i> .....	736
7C-10	Dielectric Measurements of Rotating Machines Insulation at High Temperature (200-400°C) <i>Fabrice Aymonino, T. Lebey, D. Malec, C. Petit, J. Saint Michel, and A. Anton</i> .....	740
7C-11	Complex Permittivity Characterization of Double Oxides of the Perovskite Crystal Structure <i>John A. Mergos, John E. Daskalakis, and Constantine T. Dervos</i> .....	744

## Session 8 General IV

8-1	Packet-Like Space Charge in Polyethylene Probed with a 2D-Spatial Resolution <i>Masumi Fukuma, Kaori Fukunaga, and Christian Laurent</i> .....	748
8-2	Elastic Properties and Electromechanical Coupling Factor of Inflated Polypropylene Ferroelectrets <i>Michael Wagner, Enis Tuncer, Reimund Gerhard-Mulhaupt, and S. Bauer</i> .....	752
8-3	Modeling the Effect of Ionic Dissociation on Charge Transport in Transformer Oil <i>Francis O'Sullivan, Se-Hee Lee, Markus Zahn, Leif Pettersson, Rongsheng Liu, Olof Hjortstam, Tommaso Auletta, and Uno Gäfvert</i> .....	756

8-4	Comparison of Breakdown Performances of Extruded Cables Via the Enlargement Law <i>Massimo Marzinotto, Giovanni Mazzanti, and Carlo Mazzetti</i> .....	760
8-5	Corona Characteristics in Conductor-to-Plane Gaps as Influenced by Nearby Floating Metallic Grids <i>A. Hashem, Mazen Abdel-Salam, A. Turky, and A. Abdel-Aziz</i> .....	764
8-6	Optimum Timing of Stator Winding Maintenance Based on a Combination of On-Line Partial Discharge Measurements and Visual Inspections <i>Bernhard Fruth and Stefan Lanz</i> .....	768
8-7	Examination of the Influence of Streamer Growth Criteria on Morphology <i>Minkyu Kim, Robert E. Hebner, and Gary A. Hallock</i> .....	772