Electrical Insulation News in Asia

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IEEJ

CONTENTS

TECHNOLOGY REVIEW

TECHNOLOGIES FOR TOMORROW

BOOK REVIEW

MISCELLANEOUS

PREFACE

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Network for Electric Engineering Education and Promotion of Industry - University Cooperation in Kyushu, Japan

Escape from science and engineering course has been progressive in these days worldwide. Especially, such kind of situation leads to less popularity in science and engineering course in Japan. One of the main reasons for the situation is that Modern society does not allow general people to take a direct look at core manufacturing and sophisticated technology existing behind electronic and electric products. This situation also results in technology disrespect brought by technology innovation. Companies fear alarming tendency of shortage of future electrical engineers and continuation of technology.

As one of countermeasures to tackle with these problems, Kyushu Power Academy KPA was established in 2009 to hand down importance and fascination of electrical engineering and to educate talented young people who will become leaders in the industrial and academic fields in not only Japan but worldwide with cooperation of university and college professors, researchers and industry engineers who work in Kyushu District, Japan. KPA tries to construct human network of member institutes consisting of 8 national universities, 8 private universities, 8 national college of technologies, 29 private companies, and one NPO, all located in Kyushu District. The activities of KPA are classified into two categories; to cultivate engineers and researchers through special lectures, seminars, factory and facility tours, training camp, symposium on special technological and research topics, and to nurture next generation children through manufacturing robot, motor, electronic circuit etc. These KPA activities leads to adoption of a national subsidy on Inter-Universities Cooperation of Promotion Education Program supported by Ministry of Education, Culture, Sports, Science and Technology, Japan in 2012, lasting five years. The purpose of this project is to raise students' abilities of design, presentation, communication, cooperation etc. with mutual dispatch of professors, engineers and scientists to give special lectures. The project also support financially the students to attend international conferences to present papers, and allows them to listen special lectures delivered by distinguished professors and researchers both from domestic and foreign countries.

Besides the capabilities to understand the specialties, it is also expected for the students to gain fundamentals and general-purpose ability as a working member of modern society by being conscious of the world with experience and skills to communicate and judge the conditions, leadership, international scale vision and the capability to adapt. I hope that these kinds of the activities will also help to promote research and education exchanges between countries.

Dr. Masayuki HIKITA
Professor of Kyushu Institute of Technology, Japan

OUTLINE OF TECHNICAL COMMITTEES IN IEEJ

Dielectrics and Electrical Insulation (DEI)

Chairperson: Yasuhiro Tanaka (Tokyo City University)
Secretaries: Yoitsu Sekiguchi (Sumitomo Electric Co. Ltd.)
Hiroyuki Nishikawa (Shibaura Institute of Technology)
Assistant Secretaries: Norikazu Fuse (CRIEPI*)
Takahiro Imai (Toshiba Corporation)

*CRIEPI: Central Research Institute of Electric Power Industry

The Technical Committee on Dielectrics and Electrical Insulation (**TC-DEI**) has a long history from 1970, in which the former committee named as the Permanent Committee on Electrical Insulating Materials was established in IEEJ (the Institute of Electrical Engineers in Japan). The activity of the Committee has been covering mainly solid and composite dielectric materials and their technologies. From June 2013, the TC-DEI has started a new season with a new chairperson of Prof. Y. Tanaka.

Organized events by TC-DEI

The important activity of TC-DEI is the annual domestic Symposium on Electrical and Electronic Insulating Materials and Application in Systems (**SEEIMAS**), formerly called Symposium on Electrical Insulating Materials. Furthermore, in every 3 years, we hold SEEIMAS as an international one technically cosponsored by IEEE DEIS, namely the International Symposium on Electrical Insulating Materials (**ISEIM**). This year, we held the 7th international symposium (**2014 ISEIM**) with Honorary Chair of Prof. M. Nagao and the General Chair of Prof. Y. Tanaka, in June 1-5, 2013 at Toki Messe, Niigata, technically cosponsored by IEEE DEIS, co-sponsored by Niigata University and Waseda University, in cooperation with IEEE DEIS Japan chapter. In this symposium, the TC-DEI tried some new events. Before the symposium, a workshop of "APIANS (Analysis for Polymeric Insulating materials using Advanced Numerical Simulation)" was successfully held by inviting five speakers and many participants were discussed about this advanced technology. In the symposium, the demonstration and tutorial of PEA (Pulsed Electro-Acoustic) method to measure space charge distribution in insulating materials were also held with a new concept of “practical experience”. We are deeply grateful to all participants in the symposium for their cooperation to make the academic and the friendly atmosphere on it. The symposium was successfully closed with recording the large number of participants (162 people from 16 countries). In the symposium, the next candidate place for ISEIM was opened as Toyohashi city in 2017. We strongly hope your participation in the next symposium.

The 46th SEEIMAS is now planning to be held in Kitakyushu city in September, 2015, with technically cosponsored by IEEE DEIS Japan chapter, CIGRE Japanese national Committee. Local arrangement is expected to be supported by Kyushu Institute of Technology. New materials and the improvement of their properties, functional materials, nano-composite materials, insulation systems under inverter surges, partial discharge and space charge assessment, outdoor insulations, thin dielectric films and other topics will be discussed. Especially in the next year’s symposium, the special session featuring the diagnosis of electrical insulation degradation with demonstration using actual equipment is supposed to be carried out, and it must attract participants.

Investigation Committees run by TC-DEI

Adding to organize some events, the TC-DEI runs Investigation Committees (IC's) that organize several technical meetings a year. The investigation committees are categorized into three research areas:

New materials including nano-materials related

> Advanced Nanostructure Control for High-Performance Organic Devices and Application to Life Science (07/2014 -06/2017, Chairperson: K. Kato (Niigata University)).

> Investigating Committee on Application to the Next-Generation Electronics of Organic Dielectrics, Conductive Electrical and Electronic Materials in Asian Countries (04/2014 - 03/2017, Chairperson: M. Iwamoto (Tokyo Institute of Technology)).

> Applied Technology of Advanced Dielectric Polymer Nanocomposites (04/2010 - 03/2013, Chairperson: T. Tanaka (Waseda University)). Next committee is now under consideration.

Ageing and diagnosis of electric and electronic equipment related

> Ageing and Diagnosis of Electric and Electronic Equipment Related Investigation of Degradation Diagnosis Technology of Electric Power Apparatus for its Transfer (04/2013 - 03/2016, Chairperson: Y. Ehara (Tokyo City University)).

> Testing methods of winding insulation systems for Invertor-fed motors (05/2013 - 04/2016, Chairperson: M. Nagata (University of Hyogo)).

> Current state and future view of innovative diagnostic techniques of power apparatus (10/2012-09/2015, Chairperson: M. Ikeda (NRA)).

Basic dielectric and breakdown phenomena related

> Evaluation of Properties and Improvement of Polymeric Insulating Materials for Outdoor Use (04/2010 - 03/2013, Chairperson: H. Homma (CRIEPI)). Next committee is now under consideration.

> Standardization of Calibration and Development of Application on Space Charge Measurement using PEA Method (03/2009 - 02/2012, Chairperson: Y. Tanaka (Tokyo City University)). Next committee is now under consideration.

Electrical Discharges (ED)

Chairperson: Fumiyoshi Tochikubo (Tokyo Metropolitan University)
Secretaries: Akiko Kumada (The University of Tokyo)
Hiroshi Kojima (Nagoya University)
Assistant Secretaries: Yasushi Yamano (Saitama University)
Naohiko Shimura (Toshiba Corporation)

The Technical Committee on Electrical Discharge (TC-ED) belongs to the Fundamentals and Materials Society of the IEE Japan. The origin of the TC-ED is the Expert Committee on Electrical Discharges, which was established in January 1954. That is, the TC-ED has supported the development of science and technologies on electrical discharges in Japan for a long time.

The purposes of the TC-ED are mainly the wide promotion of the research activities concerning to a variety of electrical discharges in vacuum, gas, liquid and on surfaces of materials and their applications to high technologies, especially aiming an environmentally sustainable technology for the next generation.

Several investigation committees, which are the affiliates of the TC-ED, are established every year to survey the up-to-date research subjects. The activities of these committees usually continue for three years. Each committee generates very useful technical report at the end of the active period. Two investigation committees shown in Table 1 are currently active.

The TC-ED organizes about six domestic technical meetings on electrical discharges every year. In these meetings, nearly 200 papers are presented from both academic and industrial sides. The technical meeting is also useful to train and encourage young researchers including students. The domestic technical meetings are sometimes co-organized by other Technical Committees such as Dielectrics and Electrical Insulation, Pulse Electromagnetic Energy, Plasma Science and Technology, High Voltage Engineering, and Switching and Protecting Engineering.

In order to promote the international activities in electrical discharges, "Japan-Korea Joint Symposium on Electrical Discharge and High Voltage Engineering" has been co-organized by the TC-ED with Research Group of High Voltage and Discharge, The Korean Institute of Electrical Engineers, since 1996. Next symposium will be held in Korea in 2015.

The TC-ED also contributes to organize an annual young researcher seminar in cooperation with the Institute of Engineers on Electrical Discharges in Japan for encouraging the young researchers in the field of electrical discharges. The seminar consists of lectures by senior researchers, poster presentation by the participants, and the visit tour to the facilities such as research institute. About 40 young researchers and engineers participate in the seminar and discuss vigorously the topics for two days.

Table 1 Investigation Committees in TE-ED

Chairperson	Research subjects and established time
K. Miyagi (Kanazawa Institute of Technology)	Electrical/chemical behavior and application technology in dielectric liquids (established in October 2012)
H. Sugawara (Hokkaido University)	Gas-phase simulation technologies for analyses of electrical discharges and plasmas (established in October 2014)

Plasma Science and Technology (PST)

Chairperson: Hiroshi Akatsuka (Tokyo Institute of Technology)
Vice Chairperson: Yasunori Tanaka (Kanazawa University)
Secretaries: Jaeho Kim (National Institute of Advanced Industrial Science and Technology)
Masanori Shinohara (Nagasaki University)
Assistant Secretaries: Naoki Shirai (Tokyo Metropolitan University)
Ryuta Ichiki (Oita University)

The Technical Committee on Plasma Science and Technology (TC-PST) was founded in April 1999. This committee has the basis on the plasma researcher's society that had organized Technical meeting on plasma science and technology in IEE Japan several times every year since about 30 years ago. The field of activity of this committee includes researches and investigations of various plasmas over wide ranges of their density, temperature, ionization degree, and applications such as nuclear fusion, plasma processing, and plasma chemistry.

The major activity of this committee is to succeed to organize several technical meetings on plasma science and technology every year. In 2014, three technical meetings were held, in May at Ashikaga Institute of Technology in Ashikaga, in September at Osaka Prefecture University in Osaka and in October at Horutohall OITA in Oita. In 2013, also four technical meetings were held. At each symposium, about 20–60 presentations are made. Presentations by young researchers in bachelor course and master course are strongly encouraged and appreciated. Some of the technical meetings are jointly organized with TC-PPT.

TC-PST currently runs two investigation committees as shown in Table 1. Here we introduce their activities. In the committee of the standardization of experiment and simulation modeling in liquid interface plasma, upon the research outputs of the advancement of the plasma–water applications and their reacting processes committee held in 2008–2010, investigations are made over the characteristics on plasma–water interface, overview and perspectives to activate related research activities in domestic institutes. In the committee of the propulsion performance of electrical propulsive rocket engine and its internal plasma physic phenomena, the progress of the propulsion performance and the understanding of physical phenomena in plasma are investigated by researchers of electrical engineering or plasma engineering.

Table 1. Investigation Committees in TC-PST.

Standardization of Experiment and Simulation Modeling in Liquid Interface Plasma	3 years from 2011, Chairperson: K. Yasuoka (Tokyo Institute of Technology)
Propulsion Performance of Electrical Propulsive Rocket Engine and Its Internal Plasma Physic Phenomena	3 years from 2011, Chairperson: K. Tahara (Osaka Institute of Technology)

Light Application and Visual Science (LAV)

Chairperson: Yukitaka Shinoda (Nihon University)
Secretary: Mitsuhiro Kusaba (Osaka Sangyo University)

Activities of the technical committee on light application and visual science (TC-LAV) have been covering fields of visual/optical information processing and various kinds of application of optical engineering in the wavelength region from far-infrared (THz-wave) to extreme ultraviolet. In this report, two recent topics are introduced with respect to the formation of periodic grating structures on metal self-organized by double pulse irradiations, and optical lithography onto fine-diameter pipes and wires.

The first topic," Periodic grating structures on metal self-organized by double pulse irradiations", is introduced. On metals and semiconductors under irradiation of linear polarized femtosecond laser pulses, laser induced periodic surface structures (LIPSS) were self-organized[(1),(2)] and they were oriented perpendicular to the laser polarization direction. Laser- produced LIPSS had an interspace of $0.5\lambda_L$ - $0.85\lambda_L$, which was shorter than the laser wavelength λ_L and its interspaces depended on laser fluence. This phenomenon was well explained by the parametric decay model[(3)] proposed by Sakabe *et al*. An assumption in this model is that, as a consequence of the ultrafast interaction with the laser beam, the solid surface is initially covered by a pre-formed surface plasma with a density much lower than the solid. Surface plasma waves are then induced at the interface between free space and the laser-produced low dense plasma by parametric decay process. Then, the LIPSS are self-organized. Therefore the pre-formed plasma is a key issue to discuss the formation mechanism of LIPSS. In this study, the double pulse irradiation experiment has been carried out to discuss the relation between the preformed plasma density and the LIPSS interspaces self-organized on the metal surface. Since the preformed plasma might be produced by rising edge of the laser pulse, the experiment result that is a variation of the surface plasma density might lead to a variation of the LIPSS interspaces will be expected. In the experiments, the T^6-laser system (λ_L=805 nm, τ =40 fs, 10 Hz) was used. The double pulse beam with a time delay of 160 fs was composed of a first pulse, responsible for the surface plasma formation, and a delayed pulse, responsible for the LIPSS formation. The first pulse fluence F_{PP} was varied and always kept below the formation threshold F_{TH} =60mJ/cm^2 of the periodic grating structure on Ti. The delayed pulse fluence F_{LP} was kept constant above F_{TH}. The double pulses were collimated and focused to a spot size of 45 μm with flat-topped shape on the Ti target surface with a lens f = 10 cm, at normal incidence in air. The polarization direction of the first pulse was set to be parallel to that of the delayed pulse. The target of titanium was mechanically polished and its roughness was less than 2nm. The number of irradiated double pulse beam was N=25 in all experiments. Laser-produced LIPSS were examined by scanning electron microscopy (SEM; JSM-5560, JEOL). Figures 1 show SEM images and the power spectrum of the surface structures produced by varying the first pulse fluence F_{PP} while the delayed pulse fluence F_{LP} was kept constant (F_{LP}= 60mJ/cm^2). For the laser fluence of F_{PP}= 50mJ/cm^2 and F_{PP} = 35mJ/cm^2, the LIPSS oriented perpendicular to the laser polarization direction were produced. The interspace of the LIPSS was ~ 604nm for F_{PP}=50mJ/cm^2 and ~462 nm for F_{PP}=35mJ/cm^2. In Fig.2, the dependence of the LIPSS interspaces on total laser fluence of F_{PP} + F_{LP} for Ti with double pulse irradiation is shown as solid circles. The LIPSS produced by single pulse of 160fs irradiation[4] are also plotted as open circles for comparison. Surprisingly the interspaces produced by double pulse irradiations are relatively good agreement with that of single pulse irradiations. Additionally, the interspaces of the periodic structure follow the parametric decay model prediction (solid line). The experimental results suggested that the pre-formed plasma might be produced in rising edge of laser pulse duration lead to a variation of the LIPSS interspaces.

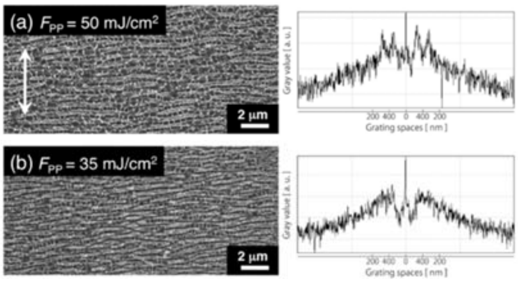

Fig. 1 SEM images of LIPSS on titanium produced by 25 pulses for double pulse irradiation.

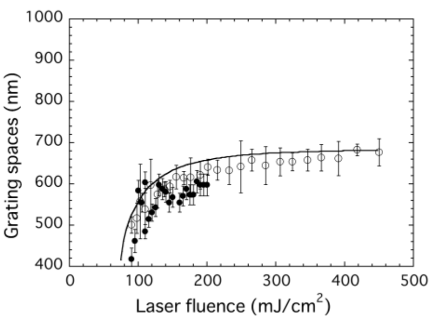

Fig. 2 Laser fluence dependence of the LIPSS interspaces produced by femtosecond laser pulses for double pulses with a time delay of 160 fs and for single pulse with duration of 160fs[4].

The second topic is optical lithography onto fine-diameter pipes and wires. Lithography is mainly used for fabricating highly integrated semiconductor devices. In this usage, very tiny patterns with down to less than 20 nm are required. For this reason, how to print such fine patterns stably with low costs is the main research target.

On the other hand, lithography is also often applied to fabrication of micro electro mechanical systems (MEMS) and their components, recently. In these applications, minimum pattern sizes are far larger than those for fabrications of semiconductor devices. For example, patterns with 5-200 μm are required. However, it is often required to print patterns on various objects instead of almost completely flat semiconductor wafers. Patterning onto pipes, rods, wires, and curved surfaces is a typical requirement.

To answer such needs, an effective original tool applicable to patterning onto fine straight pipes and wires was proposed, and excellent patterning results were shown[5]. The new method uses laser scan lithography, as shown in Fig. 3.

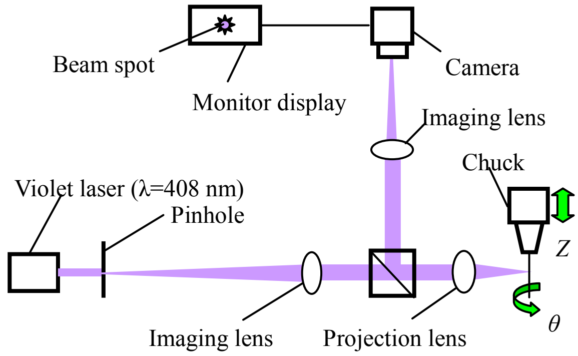

Fig. 3 Laser-scan exposure system for patterning on fine pipes.

Patterns were delineated onto fine pipes of stainless steel (SUS304) with outer and inner diameters of 100 and 60 μm by scanning the pipes to a violet laser beam. Fig. 4 shows an example of helical space pattern delineated in a positive resist of PMER P-LA900PM coated with a thickness of approximately 3 μm. It was demonstrated that fine SUS coils were fabricated by adding electrolytic etching in an aqueous solution of sodium chloride and ammonium chloride using helical resist patterns as masks for etching, as shown in Fig. 5. Caused by under-etching phenomena, obtained coil widths became narrower than the helical resist pattern widths used as the etching mask. However, width homogeneity was very good, and the coil surface was very smooth. It is expected that the new method is applicable to fabrications of various micro-components[6].

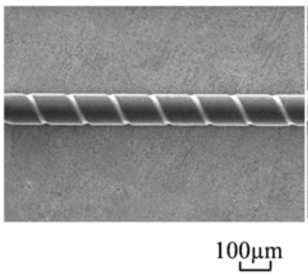

Fig. 4 Delineated helical space pattern.

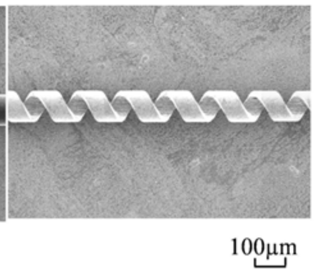

Fig. 5 Stainless-steel coil fabricated by etching.

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Electro-Magnetic Compatibility (EMC)

Chairperson: Ken Kawamata (Tohoku Gakuin University)
Secretaries: Tomoo Ushio (Osaka University), Hidenori Sekiguchi (NMRI)
Assistant Secretaries: Yu-ichi Hayashi (Tohoku University)

1. Overall of Technical Committee on EMC

The Technical Committee on Electromagnetic Compatibility (EMC) has a vital role of researching following subjects;

1. Comprehensive understanding of electrical power system and EMC issue,
2. Establish the interdisciplinary cooperation among several groups and/or institutes related with EMC problem,
3. Investigations on new and high technology for EMC,
4. Advertisement to the public on EMC issue and key technologies,
5. Introductory advertisement of international EMC standard to the domestic EMC researchers.

For these purposes the committee pays their attention to the causes of electromagnetic interference phenomena, the situation of electromagnetic interferences occurrence, the novel measurement techniques and method for EMC, the protection technology and counter measurement for EMC and international and domestic EMC regulations. The committee has been organizing four dedicated research sub-committees to realize the effective activity.

1. Investigation committee on EMC problem of smart grit and city.
2. Investigation committee on disturbance of transient electromagnetic fields to electronic equipment and wireless communications.
3. Investigation committee on technical trends in evaluation of human exposure to electromagnetic fields.
4. Investigation committee on the health risk analysis of electromagnetic field.

These sub-committees basically work independently, and each sub-committee meeting is held every two or three months regularly to announce their investigations and to share the obtained knowledge among sub-committee members. The practical period for the sub-committee activity is two or three years, and they are expected to publish their investigating results as a technical report of investigation committee or to have special conferences, which are related to their research theme.

Electromagnetic environment is the field, where electromagnetic phenomena exist. They are electromagnetic fields due to naturally-originated sources like lightning and earthquake, and artificial ones generated from electrical and electronic equipment as well as radiated from power lines or communication cables, and so force. EMC is the capability of electrical and electronic systems, equipment and devices to operate in the above-mentioned electromagnetic environment, without suffering or causing unacceptable degradation as a result of electromagnetic interference. In other words, a system is considered as electromagnetically compatible if it satisfies the following three criteria:

1. It does not cause interference with other systems;
2. It is not susceptible to emissions from other systems;
3. It does not cause interference with itself.

The problems related to EMC had been discussed in the "Special Research Committee of EMC Engineering", which was established in 1997 by IEICE and IEEJ joint venture. The high activity of the committee promoted the establishment of the technical committee on EMC in the Fundamentals and Materials Society of IEEJ. The committee was established to substitute the former committee in April 1999. Then Prof. T. Takuma of Kyoto University was elected as the first chair of the committee. After that, Prof. O. Fujiwara, Prof. Z-I. Kawasaki, and Prof. T. Funaki chaired the committee respectively from May 2002 to Apr. 2005, from May 2005 to Apr. 2008, and May 2008 to Apr. 2014. Currently, Prof. K. Kawamata succeeds the chair since May 2014. The committee holds some technical conferences. They were Oct.

25th(54th), Dec. 20th(55th) for 2013, Feb. 17th(56th), June 20th(57th) for 2014.

2. Investigation committee on EMC problem of smart grit and city

This committee, chaired by Emer. Prof. M. Tokuda in Tokyo City University, was established in Oct. 2014. The mission of this committee is that in order to clarify the issue of smart grid and city, and to organize the basic data that contribute to the EMC design of the system, it is widely investigated from the point of view of EMC. The committee is working on the following subjects.

1. Overall conditions of research and development of smart grid and city technologies over the world;
2. Trend in the standardization of smart grid;
3. EMC regulations related to smart grid and city;
4. The EMC problems in renewable energy;
5. EMC problems in generation and transformation of electricity;
6. EMC problems in transmission and distribution of electricity;
7. EMC problems in communication network for smart grid;
8. EMC problems in load and energy storage;
9. The EMC problems in wireless power transmission;

This committee envisions clarifying the EMC problems expected to occur in the smart grid and city.

3. Investigation committee on disturbance of transient electromagnetic fields to electronic equipment and wireless communications

This committee, chaired by Dr. S. Ishigami of National Institute of Information and Communications Technology, was established in Apr. 2014. The mission of this committee is to measure and figure out the characteristics associated with transient phenomena including ESD and other discharge phenomena from the view point of EMC, and to clarify the mechanism in emission of electromagnetic field by the transient phenomena. The committee also investigates an impact of the phenomena on electronic equipment and wireless communications. The subjects are summarized as followings.

1. Basics and mechanisms of transient phenomena;
2. Characteristics of electromagnetic field by the transient phenomena;
3. Optimization of ESD immunity test;
4. EMC modeling and simulation of the transient phenomena;
5. Evaluation of disturbance degree to electronic equipment and wireless communications;
6. Investigation of fault injection mechanism to communications system by impulse noise.

This committee envisions to clarify the difficulties of noise immunity for electric and electronic appliances, and to offer basic data to deal with.

4. Investigation committee on technical trends in evaluation of human exposure to electromagnetic fields

This committee, chaired by Dr. K. Yamazaki of Central Research Institute of Electric Power Industry, was established in Jul. 2013. The mission of this committee is to survey the current technical trends in numerical calculation and measurement evaluation of human exposure to electromagnetic fields. Moreover, this committee aims at accumulating the knowledge of this province by inquiring the standards and evaluation methods for electrical safety of human body, and by studying the applicability of numerical analysis of electrical magnetic field. The investigation subjects are summarized as followings.

1. Surveying the research trends for the evaluation of electrical quantities in human body with numerical analysis of electromagnetic field;
2. Surveying the trends in guidelines and standards for protection of human body to the exposure to electromagnetic field;
3. Surveying the standards and evaluation method for the indirect influence of electrical magnetic field on the human body protection and the human body safety with the facilities and instruments;
4. Find issues for future work.

This committee envisions understanding comprehensively the foundation and attitude for the indirect influence of electrical magnetic fields.

5. Investigation committee on the health risk analysis of electromagnetic field

This committee, chaired by Dr. C. Ohkubo of Japan EMF Information Center, was established in Jul. 2013 as the subsequent of special committee of studying the exposure effects of electric magnetic fields on biological system, which was established on Dec. 1995 as the direct subordinate for the president of IEEJ and dissolved on Mar. 2012. The mission of this committee is to survey the trends in the research of health risk assessment with uncertainty for the exposure of electromagnetic fields and the policy in managing the risk. The committee is working on surveying the current status, trends and future tasks of following subjects.

1. Health effects due to exposure to extremely low frequency (50/60Hz) magnetic fields emitted from electrical power equipment and household electric appliances evaluated by epidemiology,

human volunteer study, animal experiment, and cellular experiment;

2. Health effects due to exposure to intermediate frequency electromagnetic fields (300Hz – 10MHz) emitted from induction heating apparatus and wireless power transmission evaluated by epidemiology, human volunteer experiment, animal experiment, and cellular experiment;
3. Health effects due to exposure to radio frequency electrical magnetic fields in human;
4. Risk management and risk communication on electromagnetic fields;
5. Others.

This committee envisions to summarize the trends in the influence of electrical magnetic field on human body and to offer back data for the sound development in utilizing the energy with the form of electrical magnetic fields.

Electromagnetic Theory (EMT)

Chairperson:	Masahiro Tanaka (Gifu University)
Secretaries:	Yoshio Inasawa (Mitsubishi Electric Corp.)
	Keiji Goto (National Defense Academy)
Assistant Secretary:	Ryosuke Ozaki (Nihon University)

The Technical Committee on Electromagnetic Theory (EMT) is established, in order to maintain the qualified position of Japan in the field of the electromagnetic theory, by promoting the collaboration with foreigners, and by bringing up the young Japanese colleagues who would contribute to the global activation of the electromagnetic society.

The purposes of our technical committee are summarized as follows: (1) Systematization of the study of electromagnetic theory; (2) Promotion of collaboration in each field of electrical engineering using the electromagnetic theory; (3) Providing the members of IEEJ with the information and knowledge of our committee and enlightening activity of our technical committee; (4) Level up of our society by interaction with the domestic and foreign workers through the collaboration, and in the international conferences, etc.; (5) Education of electromagnetics to the students and growing up the young engineers in the next generation.

The scope of our technical committee includes: (1) Fundamental theory of electromagnetics (including relativistic theory, quantum electrodynamics, etc.); (2) Analysis theory of electromagnetic fields; (3) Numerical solutions and modeling of electromagnetic fields; (4) Simulation techniques of electromagnetic fields; (5) Scattering and diffraction of electromagnetic waves; (6) Interaction of electromagnetic fields with media (including laser, plasma, random media, etc.); (7) Nonlinear problems; (8) Inverse problem, inverse scattering; (9) Electromagnetic environment; (10) Electromagnetic effect on biological systems; (11) Other related fields.

Major activity of our committee is to pursue to organize several technical meetings. Currently, we have four technical meetings on electromagnetic theory every year. In 2014, technical meetings were held in Doshisha University, Kyoto (January), Akihabara Satellite Campus, Tokyo Metropolitan University, Tokyo (May), Muroran Institute of Technology, Hokkaido (July), Kusatsu Onsen Hotel & Spa Resort Nakazawa Village, Gunma (November). The all four technical meetings were co-sponsored by the technical committee on Electromagnetic Theory in The Institute of Electronics, Information and Communication Engineers (IEICE).

The current working investigating R&D committee in EMT is “Investigating R&D Committee on Observation, Prediction, and Simulation Technologies for Natural Hazard Mitigation by Electromagnetic Approaches,” chaired by Prof. Katsumi Hattori, Chiba University. The active period is from October 2012 to September 2015.

Instrumentation and Measurement (IM)

Chairperson:	Tetsuo Fukuchi (CRIEPI)
Vice-chairperons:	Hajime Nakajima (Mitsubishi Electric Corp.),
	Yoshitaka Sakumoto (JEMIC)
Secretaries:	Teramitsu Shirai (JEMIC), Kazuaki Kodaira (JEMIC)

Activities

The Technical Committee of Instrumentation and Measurement (IM) hosts technical meetings on electrical and electronic measurement technology for exchange of information. It also forms R&D committees to research current and future trends in measurement technology.

The IM committee consists of 13 members, including 1 chairperson, 2 vice-chairpersons, and 2 secretaries. The activities of the IM committee are as follows:

(1) General committee meetings, held 4 times annually.
(2) Technical meetings, held almost every month.
(3) Research activity in the "R&D committee for Metrological Traceability related to Smart Grid" (chairperson: Mr. Akio Iwasa, National Institute of Advanced Science and Technology).
(4) Technical visit, held about once a year.

Topics

Outstanding research papers presented at the technical meetings are described below.

1. Detection of latent defects in precisely polished surfaces by stress-induced light scattering method[1]

Precise polishing, such as chemical mechanical polishing, is used in manufacture of semiconductors and glass substrates, and is an important technology in the manufacturing process. Many polishing methods use mechanical processes such as friction, which may cause latent flaws (μm or nm order defects) on the product surface. Such flaws may degrade product reliability and cause economic loss.

The authors proposed a new method to detect latent flaws caused by polishing using the photoelastic effect and light scattering. In this method, the sample is subjected to mechanical stress (bending stress is used in Fig. 1), and change in light scattering intensity at the flaw tip due to stress concentration is detected. This method was applied to a patterned silicon wafer (diameter 200 mm), whose insulating surface (SiO_2) was polished, and numerous latent flaws were detected (Fig. 2). The presence of flaws was confirmed by atomic force microscope (AFM) observation, after the insulation layer was removed by hydrofluoric acid solution (Fig. 3).

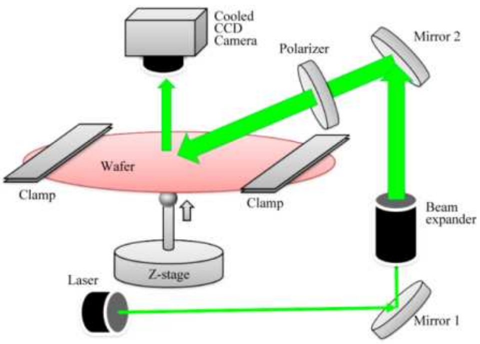

Fig. 1 Schematic diagram of inspection device of latent flaws using the stress-induced light scattering method

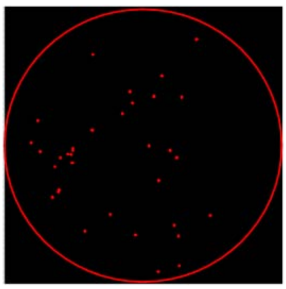

Fig. 2 Latent flaws on the insulating surface of a silicon wafer (diameter 200 mm) detected by the stress-induced light scattering method

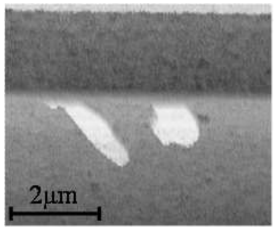

Fig. 3 AFM observation result of latent flaws (part of the flaws detected in the silicon wafer shown in Fig. 2)

These results showed that latent flaws on the polished surface can be detected using the photoelastic light scattering method.

2. Atmospheric correction technique in surface remote sensing by satellite imaging[2]

The Normalized Difference Vegetation Index (NDVI), obtained from satellite images, is a remote sensing method for observing the earth's surface. However, the observed values differ from those on the surface because of attenuation and scattering in the atmosphere. For correcting these effects, measurement values on the ground (ground truth values) are required, but these depend on the measurement location and time.

The authors proposed an atmospheric correction method which does not require ground truth values. This method is based on the atmospheric propagation model shown in Fig. 4 to estimate the surface reflectivity. The atmospheric transmission and scattering radiance are assumed to be separable into parameters depending on the wavelength band of the sensor and parameters depending on the atmospheric conditions. The former parameters are characteristic values, and the latter parameters can be estimated from image analysis. In this manner, correction can be applied to images at arbitrary locations and time.

NDVI distributions before and after correction are shown in Fig. 5. The values increased after correction, and the vegetation regions are more strongly stressed. The NDVI values in Fig. 5 and ground truth values are compared in Fig. 6. Concrete and soil were considered in addition to vegetation. Atmospheric correction resulted in values closer to ground truth values, which confirmed the effect of the correction.

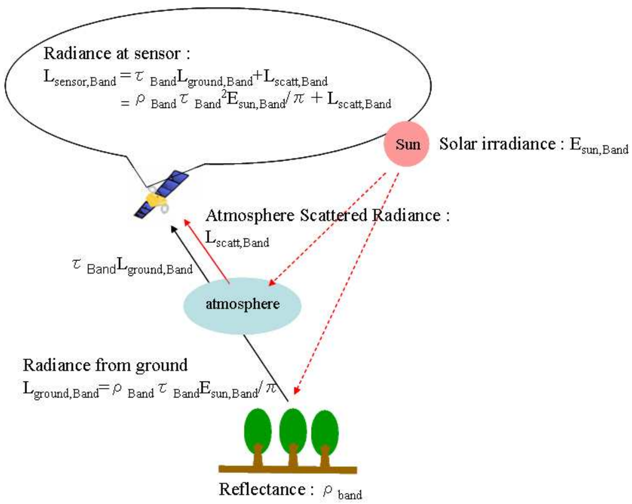

Fig. 4 Atmospheric propagation model

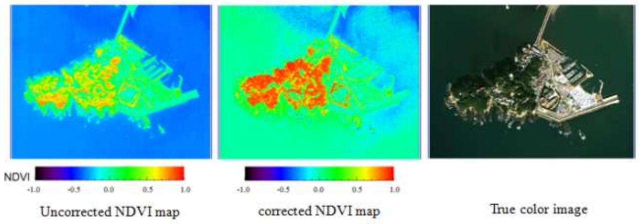

Fig. 5 Distribution of NDVI

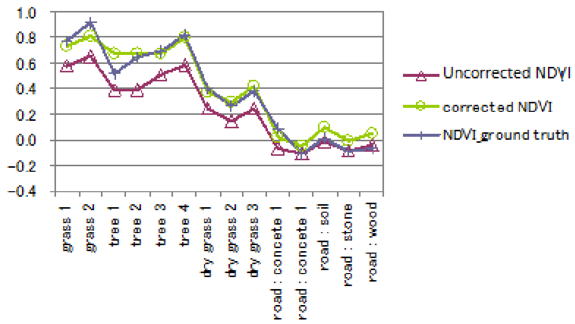

Fig. 6 Measurement result of NDVI

3. Suppression of clutter by CFAR circuit using partial Q-Q plot[3]

Constant False Alarm Rate (CFAR) is an adaptive algorithm used in radar systems to detect target returns against a background of noise and clutter. LOG/CFAR is a type of CFAR which is currently in use, and is based on the fact that the output variance is constant when the clutter intensity obeys a Rayleigh distribution. However, improvement in radar resolution has shown that the clutter does not follow a Rayleigh distribution. The authors proposed a CFAR circuit using the partial Q-Q plot, and confirmed its effect by applying it to S-band radar measurement of an observation target in the presence of sea clutter.

Table 1 Specifications of the radar

TOKIMEC BR-3340 MA-S314	
transmission frequency	3.05 GHz
peak transmission power	30 kW
pulse width	0.5 µs
pulse repetition frequency	1,600 Hz
antenna length	14 ft
antenna rotation rate	22 r.p.m.
horizontal beam width	1.8 deg
vertical antenna width	25 deg
Polarization	horizontal

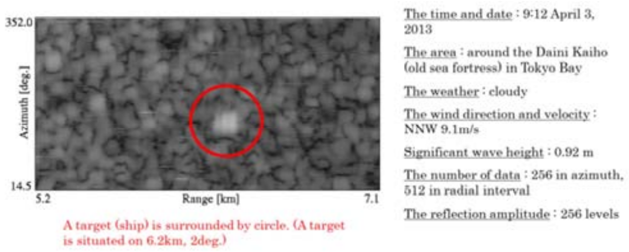

Fig. 7 Observation result

Specifications of the S-band radar are shown in Table 1. Measurement results are shown in Fig. 7, in which the target vessel is indicated by a red circle. This vessel is the Daikoku Maru, length 98 m, whose information was obtained from the Electronic Chart Display and Information System (ECDIS).

The CFAR circuit using the partial Q-Q plot is shown in Fig. 8. The CFAR characteristics are obtained by using the conventional LIN/CFAR circuit, obtaining the shape parameter c in the Weibull distribution by the partial Q-Q plot, and setting the corresponding threshold T_h. The CFAR processed result, in the case of number of samples N=256 and false alarm rate $P_N=10^{-3}$, is shown in Fig. 9. The clutter has been suppressed, and the target vessel has become more visible. In this case, the target-to-clutter ratio was (T/C) =46.76 dB.

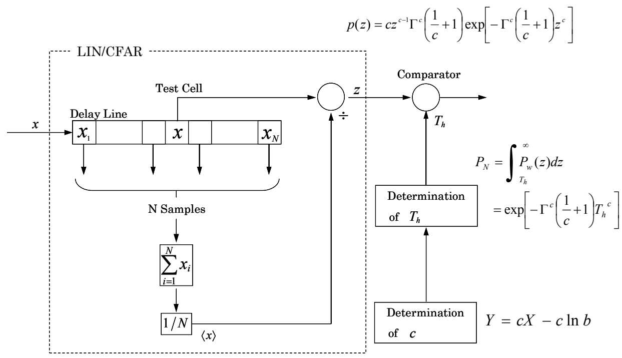

Fig. 8 CFAR circuit using partial Q-Q plot

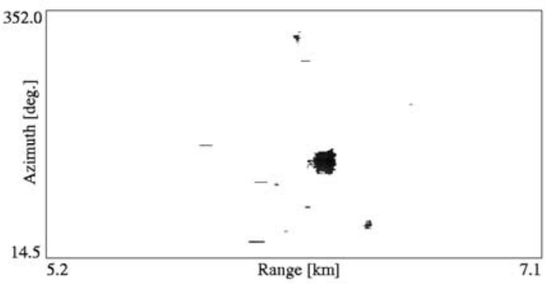

Fig. 9 CFAR processing result (N=256, $P_N=10^{-3}$)

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(3) T. Matsukuma, S. Sayama: "Study on suppression of clutter by advanced CA LOG/CFAR circuit and CFAR circuit using adaptive Q-Q cell-averaging", IEEJ, IM-13-024 (2013)

WEB site and authors

Activity of our committee is also described in our website (http://www2.iee.or.jp/~aim/). Written by T. Fukuchi (CRIEPI, e-mail: fukuchi@criepi.denken.or.jp), Y. Sakata (AIST), M. Sakai (Mitsubishi Electric), S. Sayama (National Defence Academy)

Pulsed Electromagnetic Energy (PEE)

Chairperson: Sunao Katsuki (Kumamoto University)
Vice-Chairperson: Koichi Takaki (Iwate University)
Secretary: Takashi Kikuchi (Nagaoka University of Technology)
Assistant Secretary: Jun Hasegawa (Tokyo Institute of Technology)

The Technical Committee on Pulsed Electromagnetic Energy (TC-PEE) was founded under the Fundamentals and Materials Society of the IEEJ in June 1999. The activity of TC-PEE covers the collection and spread of information on pulsed power technology and its applications. Using pulsed power technology, very high power electromagnetic pulses can be produced, which are used for generation of high power lasers, high power electromagnetic waves, short wavelength light or high power particle beams. In addition, while huge machines with extremely high output power released in a single shot are developed at the start of the pulsed power technology, many smaller devices equipped with a lot of modulators, which are able to control the pulse waveform accurately by using high speed semiconductor switch elements but possess only the ability of smaller output energy, are now being developed and used in series-parallel connection to attain higher average power in high repetition rate operation. Thus the pulsed power technology becomes to be widely recognized as the basis of many technologies.

Recent activities of TC-PEE

The major activity of TC-PEE is to organize technical meetings. In 2014, 3 technical meetings were held, including the joint meetings with the Technical Committees on Electrical Discharges (TC-ED) and and/or on Plasma Science and Technology (TC-PST). Also TC-PEE technically co-sponsored the 5th Euro-Asian Pulsed Power Conference. TC-PEE selects young researchers who make excellent presentations at the technical meetings, for the IEEJ excellent young researcher awards. There are two technical investigation committees on "*agricultural applications using pulsed power and plasmas*" and on "*status and outlook of pulsed power technology in extremely high power level*" running under TC-PEE. One of four steering meetings was carried out online using a web-based meeting system for the first trial, which went well. We will have more opportunities to hold such online meetings.

Investigation Committee of Agricultural Applications Using Pulsed Power and Plasmas

This investigation committee is aimed to conduct an investigation on the present status of research and development in agricultural applications using pulsed power and plasmas. 22 committee members from various fields are joined and exchange the information each other. The activities are to hold regular meetings and symposiums in addition to the publication of the research report. 3 regular meetings were held every year. In the meeting, in addition to reports from the committee member, a guest speaker was invited from industry in order to close the perspective gap between academia and industry. The attendee of meeting reached over 20 for each time. Two symposiums were held in last academic year: "*Research Innovation of Plasma-Agriculture Fusion Science*" for the 30th Annual Meeting of the Japan Society of Plasma Science and Nuclear Fusion, and "*Application of Pulsed Electromagnetic Energy for Agriculture, Fisheries and Foods*" for the 2014 Annual Meeting of the Institute of Electrical Engineers of Japan. Two special issues were promoted. The special issue of The Journal of the Japan Society of Plasma Science and Nuclear Fusion Research (Vol. 90, No. 9) was published in September 2014. The papers can be downloaded from following site; *http://www.jspf.or.jp/journal/current.html*. Other special issue in IEEJ Transactions on Fundamentals and Materials is scheduled to be published in June, 2015. The final report of the committee will also be published in December, 2014.

Investigation Committee on the Status and Outlook of Pulsed Power Technology in Extremely High Power Level

This investigation committee makes efforts to enhance activities in pulse power technology and high energy density physics. 3 meetings were held at Tokyo Institute of Technology (December 5, 2013), National Institute for Fusion Science (January 8, 2014) and Tokai University (March 28, 2014). In the meeting, the present status of research activities was discussed including its applications to high energy density physics, laboratory astrophysics, energetic radiation sources, material science at extreme state, radiation hydrodynamics, intense shock waves, intense particle beams, high power accelerators and fusion science. As the field has a multi-disciplinary nature, extensive discussions of related subjects are difficult in conventional societies. The committee members will continue to make efforts to provide a forum for the discussion on the field of pulse power technology. Goals of the committee are to overview the state of art of the pulse power technology, and to get an outlook on the future direction of the technology in high power level. The committee is planning to publish a Special Issue of IEEJ on "*pulse power technology*" in January 2015.

5th Euro-Asian Pulsed Power Conference (EAPPC2014)

EAPPC2014 was held in Kumamoto, from September 8 to 12, 2014 with the technical co-sponsorships of six scientific societies including TC-PEE, to provide a forum for the exchange of scientific and technical information between industry, academic institutions and research organizations, on the broad range of current and emerging research areas of pulsed power technology. 231 abstracts were submitted from 15 different countries all over the world. A strong technical program was assembled with 4 plenary talks by worldwide recognized scientists, 73 oral talks (13 invited) in two parallel sessions and 154 poster presentations. 6 industrial exhibitors presented their latest technologies and products. The social program opens with a welcome reception on Monday evening at the Kumamoto Hotel Castle, followed by the conference banquet on Thursday evening at the same hotel (Fig. 1) and an excursion to the active volcanic crater of Mt. Aso on Friday. The next EAPPC will be held at Estoril, Portugal in 2016.

Fig. 1 Banquet of EAPPC2014.

Electrical Wire and Cables (EWC)

Chairperson: Yasuo Suzuoki (Nagoya University)
Secretaries: Kenichi Furusawa (J-Power Systems Corporation)
Akitoshi Watanabe (VISCAS Corporation)
Kouji Miura (EXSYM Corporation)

Technical Committee on Electrical Wire and Cables (TC-EWC) is a committee organized in the IEEJ Power and Energy Society, and is comprised of members from cable manufacturers, power utilities, railway companies, universities and related research institutes such as Japan Electric Cable Technology Center (JECTEC) and Central Research Institute of Electric Power Industry (CRIEPI). The technical committee organizes technical meetings to promote R&D activities in this field and provides an opportunity to present technical achievements. One technical meeting was so far held in 2014, which was on degradation diagnosis of wires, cables and power apparatuses and was held as a joint meeting of TC-DEI and TC-EWC. The technical committee also held a forum on the status quo and problems of diagnosis and evaluation methods for distribution wire and cables. The technical committee plans to organize 3 more technical meetings, a forum and a symposium in FY2014. The technical meetings will be on (i) snow damage on transmission lines, (ii) insulation technologies of cable systems, treeing, tracking and insulating materials, and (iii) trends and problems of maintenance technologies for transmission and distribution lines, two of which will be jointly organized by TC-DEI and TC-EWC. The symposium will be on domestic and overseas technical trends in overhead transmission cables and their accessories.

In addition to organizing such meetings, forums and symposia, the technical committee supervises investigation committees dealing with subjects related to electrical wire and cables. During the last several years, investigation committees were organized on the following subjects, i.e. technology of XLPE power cables and associated accessories for underground power distribution, technical trend of environmental tests for insulation materials of distribution wires and cables, recent technological trends in overseas power transmission cables, and trend of recycling technology for wires and power cables. The technical report of the last committee is under preparation and will be published in FY2014. The Investigation Committee for Domestic and Overseas Technical Trends in Overhead Transmission Cables and Their Accessories is now in action and the Investigation Committee for the Status Quo and Problems of Diagnosis and Evaluation Methods for Distribution Wire and Cables will be launched in FY2014.

Forum on the status quo and problems of diagnosis and evaluation methods for distribution wire and cables.

Metal and Ceramics (MC)

Chairperson: Nobuyuki Yoshikawa (Yokohama National University)
Secretaries: Nobuya Nanno (National Institute for Material Science)
Kio Kimura (Furukawa Electric Co., Ltd.)

The Technical Committee on Metal and Ceramics (TC-MC) had established in the Institute of Electrical Engineers of Japan (IEEJ) in 1999 to promote science, technologies and industry concerning metal and ceramic materials. Because typical electric and electronics devices and instruments are made of metal and ceramic materials, the TC-MC is one of fundamental technical committees in the Fundamental and Materials Society, which is referred as A-Society, in IEEJ.

The TC-MC covers wide range of topics related to metal and ceramic materials, which include normal conductor materials, superconductor materials, semiconductor materials, optical materials, insulator material, thermodynamic materials, and so on. The main mission of the TC-MC is to investigate application technologies and processing and evaluation technologies concerning the above-mentioned materials and find the research and development directions of these technologies. Materials and technologies covered in the TC-MC are shown in Fig. 1.

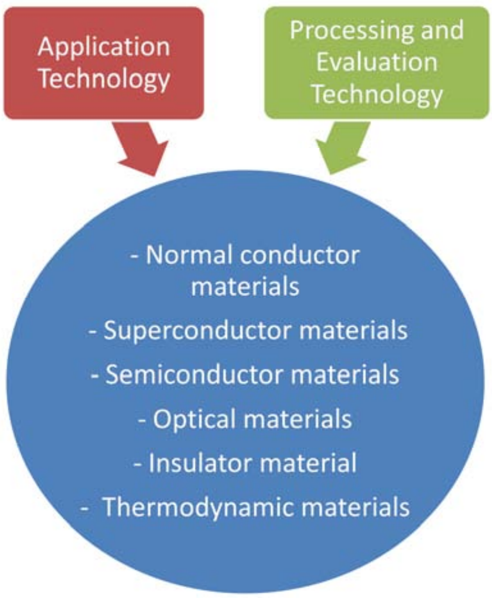

Fig. 1 Technologies and materials covered in the Technical Committee of Metal and Ceramics

Recent rapid progresses in electrical and electronics technologies brought about a lot of new materials related to metal and ceramics materials, including carbon nano-tube materials, functional diamond materials and fuel cell materials, and also produced many new applications, such as battery applications, solar cell applications and thermoelectric applications, all of which are covered in the TC-MC. Among these new materials, we especially focus on cutting-edge technologies based on superconducting materials for power and electronics applications recently.

The activities of the TC-MC are mainly composed of three parts: one is the Symposium in the National Convention of the IEEJ, where recent research results and trends are presented and discussed. The recent themes discussed in the Symposium are listed in Table 1.

The second activity is the Study Meeting for Young Scientists, where the promotion and stimulation of active studies of young scientists are performed through their mutual interactions at the meeting for specific topics. A list of the recent Study Meeting for Young Scientists is shown in Table 2. Recent themes of the meeting are “advanced superconducting materials”.

The third activity is the Investigation Committee, where new research areas are intensively investigated to find out the present status and the research directions of these new topics. Typical investigation period of the committee is three years, and at the end of the investigation period, a technical report of the Investigation Committee is published. Right now, one Investigation Committee is in operation, whose research subject is “low temperature electronics based on phase engineering.” Recently a new research field based on the manipulation of the phase of superconducting materials by using magnetic materials and other disordering materials becomes a hot topic because a lot of new applications, such as high-speed integrated circuits and high-sensitive superconducting detectors are expected. The detail information of the ongoing Investigation Committee is shown in Table 3. Fig. 2 shows a microphotograph of a superconducting floating-point adder operating at 50 GHz, which is one of important applications in “the low temperature electronics based on phase engineering.”

Table 1 Symposiums in the National Convention of the IEEJ arranged by the TC-MC

Theme	Date	Site
Development and problem of the high-efficiency solar cell	2009.03.19	Hokkaido University
Metal and ceramic materials in energy strange systems	2010.03.19	Meiji University
The 100th anniversary symposium for superconductivity discovery	2011.12.12	IEEJ meeting room
The latest research-and-development trend about thermoelectric material and its application	2013.3.19	Nagoya University

Table 2　Study Meetings for Young Scientist in the TC-MC

Theme	Date	Site
Recent research progress in advanced superconducting materials (II)	2011.10.23	University of Tokyo
Recent research progress in advanced superconducting materials (III)	2012.12.16	University of Tokyo
Recent research progress in advanced superconducting materials (IV)	2013.11.17	University of Tokyo

Table 3　Investigation Committee in the TC-MC

Research Subject	Chairperson (Affiliation)	Period	Remarks
Low temperature electronics based on phase engineering	Prof. Akira Fujimaki (University of Nagoya)	2013.10-2016.09	Open

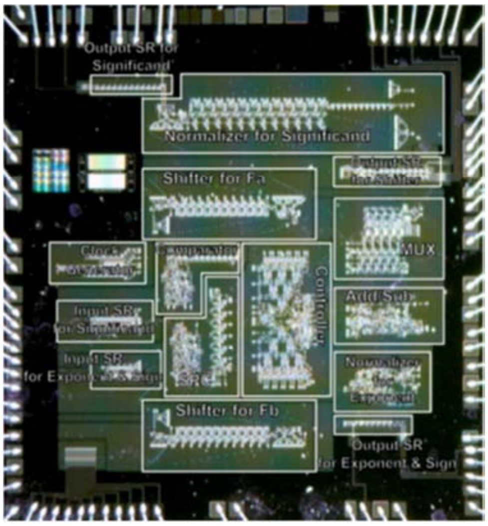

Fig. 2　Microphotograph of a superconducting floating-point adder operating at 50 GHz.

IEC TC15 Japanese National Committee

Chairperson: Yoshiaki Yamano (Chiba University)
Secretaries: Yoshio Wakashima (Japan Electrical Safety & Environment Technology Lab.)
Associate Secretary: Akihiro Kawaguchi (Japan Electrical Safety & Environment Technology Lab.)

The scope for IEC TC15 is to prepare international standards including specifications for solid electrical insulating materials alone and in simple combinations. This includes coatings which are applied in the liquid state but cure to solids, such as varnishes and coatings. Although TC15 Japanese National Committee has certainly the same scope as that for IEC TC15, its mission is accomplished by consulting with Japanese industrial situations and market in the world.

IEC TC15 establishes definitions, general requirements and specification sheets for individual types of materials. The standards include test methods and guidance where these are required for the specifications. The current activities of TC15 are carried out by 5 working groups (WGs) and 4 maintenance teams (MTs). IEC TC15 has now more than 160 standards published, and 9 work programs for standardization are in progress.

Japanese national committee for TC15 held meetings of three times last year with the attendee of about 15 members. The members are from manufactures, user (customers), laboratories and universities. Over 30 documents for standardization from IEC Central Office have been circulated around specialists of the members, including drafts of CD, CDV and FDIS. They made comments on them to improve the drafts for international industrial situations and market.

To accomplish the tasks of the WGs and MTs in TC15, the experts from Japan are participating in MT 3 (plastic films), WG5 (flexible insulating sleeving), and WG 9 (cellulosic materials). They play active parts in standardization of new work item and revision of the present standards.

Especially in MT3, which deals with plastic films for electrical insulation, IEC 60674-2 (Methods of test) and IEC 60674-3-8 (PEN film specification) are now in revision works by a Japanese convener. CD was circulated in December last year. Methods for measurement of dc breakdown voltage using metal electrode was newly added to the draft for the revision. The CD was partially modified by the CC (Comment Compilation) from some countries to arrange CDV for the next stage. CDVs for these new revisions will be in a circulated stage within this year.

In WG 9, Japanese expert is proposing to include specifications of an insulating cellulose paper for coil winding include in Part 3 sheet of IEC 60554 in order to offer the appropriate and useful specifications to the market in Asia. The draft will be discussed in the next WG meeting.

IEC TC15 international meeting has been annually held. However this year, the meeting was not held by unexpected accident. Although a plenary meeting is not held this year, activities of WGs and MTs are kept continuously high as was in the past years. The meeting in the next year is scheduled to be held in Prague in early June.

IEC TC112 Japanese National Committee

Chairperson: Tatsuki Okamoto (CRIEPI*)
Secretaries: Hiroya Homma (CRIEPI*)
Hiroaki Uehara (Kanto Gakuin University)
*CRIEPI: Central Research Institute of Electric Power Industry

IEC TC112 Committee deals with many international specifications on evaluation and qualification of electrical insulating materials and systems. TC112 deals with international standards of thermal endurance test methods of material life and related specifications. TC112 Japanese Committee was established to deal with the same standards of TC112 and related Japanese standards. TC112 Japanese Committee starts almost the end of 2005 based on the part of TC15 and TC98. TC98 and the related sub-group in TC15 were disbanded after the establishment of TC112.

TC112 international committee is including eight working groups and dealing with more than 53 standards. TC112 Japanese committee also includes eight corresponding working groups and one more WG that deals with Japanese related standards. Working group structure is shown in Table 1.

As shown in the table each WG deals with several standards. Three conveners of international WGs (WG2, WG7, WG8) are Japanese and in this reason Japanese members are very active in this standard region. Japanese committee has four meetings in a year and discusses related standards and future activities. The international committee was held in Toronto, Canada in October, 2013. Figures 1 and 2 show the some part of the international committee and the international supper with Chinese members.

Recent standards discussed in TC112 are partly listed:

WG1: IEC/TS 60216-7 Ed.1.0 Accelerated determination of thermal endurance index (TI) and relative thermal endurance (RTE) using analytical test methods.

WG2: IEC 61244-1 TS Ed.2.0 Determination of long-term radiation ageing in polymers - Part 1: Techniques for monitoring diffusion-limited oxidation and IEC 61244-2 TS Ed.3.0 Determination of long-term radiation ageing in polymers - Part 2: Procedures for predicting ageing at low dose rates.

WG3: IEC/TS 61934 Electrical insulating materials and systems – Electrical measurement of partial discharges (PD) under short rise time and repetitive voltage impulses, IEC/TS 61251 Ed. 2.0, Electrical insulating materials - A.C. voltage endurance evaluation – Introduction, IEC 60243-2 Ed. 3.0, Electric strength of insulating materials - Test methods - Part 2: Additional requirements for tests using direct voltage，IEC 60243-3 Ed. 2.0, and Electric strength of insulating materials - Test methods – Part 3: Additional requirements for 1,2/50 µs impulse tests

WG4: IEC 62631-2-1 Ed. 1.0 Determination of Permittivity and Dielectric Dissipation Factor (AC Methods) - Technical Frequencies (1 Hz to 100 MHz), IEC 62631-3-1 Ed. 1.0 Determination of Resistive Properties (DC Methods) - Volume Resistance and Volume Resistivity, IEC 62631-3-2 Ed. 1.0 Determination of Resistive Properties (DC Methods) - Surface Resistance and Surface Resistivity, IEC 62631-3-3 Ed. 1.0 Determination of Resistive Properties (DC Methods) - Insulating Resistance

WG5: Revisions of some standards.

WG6: IEC 61858-1 Ed. 1.0 Electrical insulation systems - Thermal evaluation of modifications to an established wire-wound EIS, IEC 61858-2 Ed. 1.0 Electrical insulation systems - Thermal evaluation of modifications to an established form-wound EIS

WG7: IEC/TR 60493-3 "Guide for the statistical analysis of aging test data part.3: Minimum specimen numbers with given experimental data (tentative title)

WG8: IEC/TR 62836 Measurement of Internal Electric Field in Insulating Materials used by Pressure Wave Propagation Method

WG9: JIS C 2110-1(Breakdown strength—ac test), JIS C 2110-2(Breakdown strength—dc test)), JIS C 2110-3 (Breakdown strength—impulse test), JIS C 2142(Condition adjustment)

Table 1 WG organization of Japanese TC112

WG 1	Thermal endurance
WG 2	Radiation
WG 3	Dielectric/Resistive properties
WG 5	Tracking
WG 6	General methods of evaluation of electrical insulation
WG 7	Statistics
WG 8	Various material properties
WG 9	Japanese standards

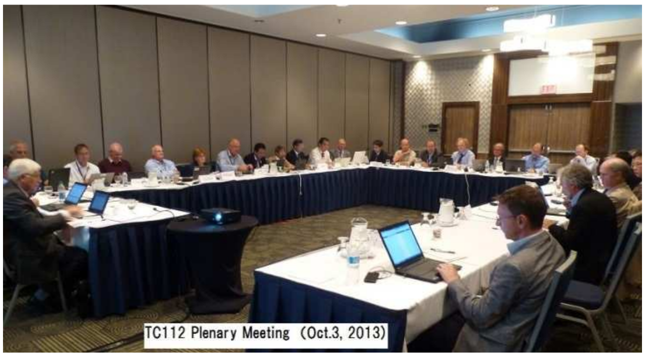

Fig 1. TC112 Plenary Meeting on Oct.3, 2013

Fig.2 Supper of some Chinese and Japanese members

CIGRE SC D1 Japanese National Committee
(Materials and Emerging Test Techniques)

Chairperson: Naohiro Hozumi (Toyohashi University of Technology)
Secretary: Toshio Shimizu (Toshiba Corporation)
Assistant Secretary: Tsuguhiro Takahashi (CRIEPI)

CIGRE (International Council on Large Electric Systems) has 16 Study Committees (SC) belonging to each of following 4 categories: A (Equipment), B (Subsystems), C (Systems) and D (Horizontal). Among them, our SC D1 has a horizontal character and contributes to other CIGRE SC's. The activity of CIGRE SC's is principally research oriented one.

SC D1 has now following 6 Advisory Groups (AG): Strategic AG, Customer AG, Tutorial AG, AG D1.01 (Insulating Liquids), AG D1.02 (High Voltage Testing and Diagnostic), AG D1.03 (Insulating Gases) and AG D1.04 (Insulating Solids). SC D1 consists of these AGs and following 28 WGs.

[Liquids] WG D1.29 (PD recognition), WG D1.31 (Dielectric performance of insulating liquids), JWG A2/D1.41 (HVDC transformer polarity reversal: Role of oil conductivity), JWG A2/D1.46 (Field experience with transformer solid insulating ageing markers), JWG D1/A2.47 (New frontiers of DGA interpretation for transformers and their accessories), JWG A2/D1.51 (Improvement to partial discharge measurements for factory and site acceptance tests of power transformers), WG D1.52 (Moisture measurement in insulating fluids and transformer insulation).

[Testing & Diagnosis] WG D1.53 (Ageing of upgraded cellulose and cellulose impregnated in ester liquids and other liquids), WG D1.35 (Performance of high-voltage and high-current measurement systems), WG D1.36 (Requirements for dielectric testing of UHV equipment), WG D1.37 (Maintenance and evaluation of measuring procedures for partial discharge testing), WG D1.38 (Test techniques common to high temperature superconducting power applications), WG D1.39 (Methods for diagnostic/failure data collection analysis), WG D1.44 (Testing of naturally polluted insulators), WG D1.45 (Testing of insulator performance under heavy rain), WG D1.50 (Atmospheric and altitude correction factors for air gaps and clean insulators), WG D1.54 (Basic principles and practical methods to measure the AC and DC resistance of conductors of power cables and overhead lines), WG D1.55 (Partial discharge detection under DC stress).

[Gases] WG D1.25 (Application Guide for PD Detection in GIS using UHF or acoustic method), WG D1.51 (Dielectric performance of eco-friendly gas insulated systems), JWG D1/B3.57 (Dielectric testing of gas-insulated HVDC systems).

[Solids] WG D1.23 (HVDC ageing, diagnostic and accelerated life testing of polymeric material), WG D1.27 (Material properties for new and nonceramic insulation), WG D1.40 (Functional nano-materials), WG D1.42 (Radiation ageing of polymeric insulating material), WG D1.43 (Rotating machine insulation voltage endurance under fast repetitive voltage transients), WG D1.48 (Properties of insulating materials under VLF voltages), JWG D1/B1.49 (Harmonized test for the measurement of residual inflammable gases), WG D1.56 (Field grading in insulation systems), WG D1.58 (Evaluation of dynamic hydrophobicity of polymer insulating materials), WG D1.59 (Methods for dielectric characterization of polymeric insulating materials for outdoor applications).

The preferential subjects for the 2014 SC D1 Paris group meeting were PS1: Electrical insulation systems under DC voltage Material properties Space and surface charges & Potential distribution Long term performance, PS2: Emerging test techniques and diagnostic tools UHVAC and HVDC atmospheric and altitude correction, harsh conditions tools in modern asset management, and PS3: Innovative application of new materials field grading eco-friendly super conductivity.

From Japan, following 3 papers were accepted: "Fundamental Study on Detection Method of Residual Charge from Water-tree Degraded XLPE Cables with Pulse Voltage" by T. Kurihara, T. Okamoto, T. Tsuji, K. Uchida, MH. Kim, N. Hozumi (PS1), "Study of AC Insulation Tests for UHV Substation Equipment - Partial Discharge and Combined Lightning Impulse Voltage Tests -" by S. Okabe, T. Tsuboi, G. Ueta, T. Kobayashi, H. Koyama, H. Wada (PS2), and "Electric Field Grading Techniques in Power Apparatus Using Functional Materials" by N. Hayakawa, K. Kato, H. Okubo, H. Hama, Y. Hoshina, T. Rokunohe (PS3).

The next meeting is scheduled to be held in Rio de Janeiro, Brazil on September 13-18, 2015, The Japanese National SC D1 will hold 2 or 3 meetings for its preparation.

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Conference Records

2014 International Symposium on Electrical Insulating Materials (ISEIM 2014)

The International Symposium on Electrical Insulation Materials (ISEIM) is positioned as the international version of annual domestic Symposium on Electrical and Electronic Insulating Materials and Applications in Systems (SEEIMAS), formerly called Symposium on Electrical Insulating Materials (SEIM). Continuing a series of conferences that began in 1995, the ISEIM held its 7th conference by the Technical Committee of Dielectric and Electrical Insulation of IEEJ on June 1–5 2014, in Toki Messe, Niigata, Japan.

The conference covered nanotechnology, material aging, phenomena under inverter serge, and several other fundamental material researches. There were 155 papers registered for the conference with 5 invited lectures for the workshop, and 60 oral presentations and 82 papers were presented through two kinds of poster presentations. Eight demonstration presentation on space charge measurement systems were also held as described later. These presentations are categorized into more than 11 topics, as shown in Fig. 1. During the conference, 162 participants from 16 different countries (as listed in Table 1) working with industry, government, and research and academic institutions shared their experiences and discussed the latest developments and future challenges confronting the field. Fig. 2 shows a group photo from the conference.

The conference commenced with opening remarks by Prof. Y. Tanaka of Tokyo City University and General Chair of the symposium. Prof. J. K. Nelson of Rensselaer Polytechnic Institute delivered the 6th Inuishi Memorial Lecture. His presentation, "Nano-dielectrics - the First Decade and Beyond," consisted of research carried out on the theoretical and empirical analyses of polymer nanocomposites (Fig. 3). A plenary lecture on the space charge formation in polymeric materials and the lifespan of the materials

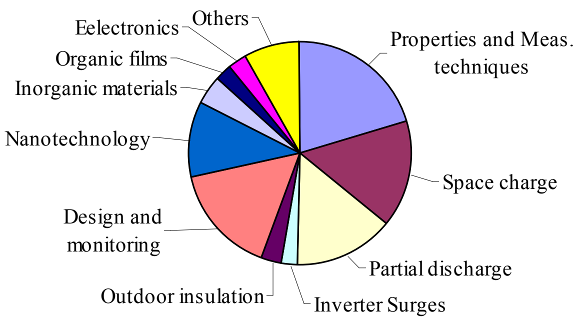


Fig. 1. Constituents of presentations.

Table 1. Number of participants by country.

Japan	101	China	22
France	7	Sweden	6
Korea	5	Australia	3
Canada	3	Thailand	3
USA	2	India	2
Indonesia	2	Italy	2
England	1	Spain	1
Switzerland	1	The Netherlands	1
		Total	162

Fig. 2. Group photo.

was delivered by Prof. G. Chen of the University of Southampton and Xi’an Jiaotong University. Eleven invited lectures were provided during the sessions in order to discuss issues from the key fields. Table 2 lists the speakers and the title of their lectures.

Fig. 3. J.K. Nelson at his Inuishi Memorial Lecture.

Table 2. Invited lectures on the sessions.

Speaker	Affiliation	Title
J.K. Nelson	Rensselaer Polytech. Inst., USA	Nanodielectrics - the first decade and beyond
George Chen	Univ. Southampton, UK	The missing link - the role of space charge in polymeric insulation lifetime
M. Fréchette	Inst. Rec. d’Hydro Québec, Canada	Modelling the dielectric permittivity of nanocomposites – the overlap model
T. Czaszejko	Monash Univ., Australia	Acoustic emission from partial discharges in cable termination
Suwarno	Inst. Teknologi Bandung, Indonesia	Phase resolved measurement and simulation of partial discharges in solid and liquid insulating materials
C. Laurent	Univ. Toulouse, France	Evidence of exciton formation in thin polypropylene films under ac and dc fields and relationship to electrical degradation
Yi Yin	Shanghai Jiaotong Univ., China	Investigation of space charge behavior of HVDC XLPE Cables using PEA Method
Reddy C. C.	Indian Inst. Tech. Ropar, India	Role of external and internal parameters on the space charge formation in dielectrics
Shengtao Li	Xi’an Jiaotong Univ., China	The effect of charge recombination on surface potential decay crossover characteristics of LDPE
P.H.F. Morshuis	Delft Univ. Tech., the Netherlands	Experimental investigation on the role of corrosive sulphur on the development of partial discharges in power transformers
R. Sarathi	Indian Inst. Tech. Madras, India	Understanding the partial discharge activity in liquid nitrogen under harmonic ac voltages

A special poster session called “Mutual Visiting-Type Poster (MVP) Session” was organized to encourage young researchers to expand their activities. This is one of our most important missions. Young researchers were encouraged to showcase their presentations and research abilities through the poster sessions. Presenters from similar research fields were divided into small groups and were required to give their own poster presentation to the other members of the group. After the short presentations, the other group members questioned the presenter. All members of the group delivered their presentation in the same way; this allowed all participants to engage in meaningful and productive discussions and overcome language barriers (Fig. 4). Eight outstanding presenters listed in Table 3 were presented with awards during the conference banquet. S. Yoshida of Kyushu Institute of Technology won “the most valuable presentation” award, which enabled the researcher to partake in the Korea-Japan Young Researcher Exchange Program. This new award that offers winners financial aid to deliver presentations was inaugurated at this symposium. During this symposium, Mr. Jae-Sang Hwang of Hanyang University presented his study as part of this exchange program. The other important mission of the symposium was to provide researches

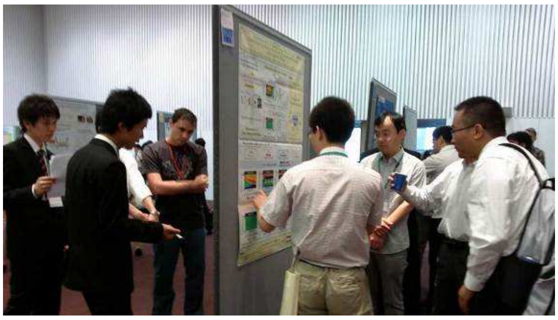


Fig. 4. Snap shot at the MVP Session.

Table 3. Presentations awarded for valuable presentations in MVP sessions.

Speaker	Affiliation	Title
M. G. Niasar	KTH Royal Inst. Tech., Sweden	Effect of partial discharges on thermal breakdown of oil impregnated paper
S. Yoshida	Kyushu Inst. Tech. Japan	Characteristics of discharge generation across insulation barrier in the oil/ pressboard composite insulation system
A. T. Hoang	Chalmers Univ. Tech., Sweden	Partial discharge behavior of a newly developed enamel insulation at various voltage rise times
Y. Murakami	Meijo Univ. Japan	Effect of component of liquid sample on sterilization of E. coli by high electric field pulse
T. Kato	Tokyo City Univ. Japan	Characteristics of space charge behavior and conduction current in XLPE and annealed polyethylene under High DC stress
P. Yang	Waseda Univ., Japan	Analysis on thermally stimulated currents in Polyethylene-terephthalate and polyethylene-naphthalate
P. Mancinelli	Univ. Bologna, Italy	LDPE composite materials obtained from building blocks containing standardized graphene interfaces
J. Guo	Xi’an Jiaotong Univ., China	Study on electrical properties of micro-nano structured epoxy composites

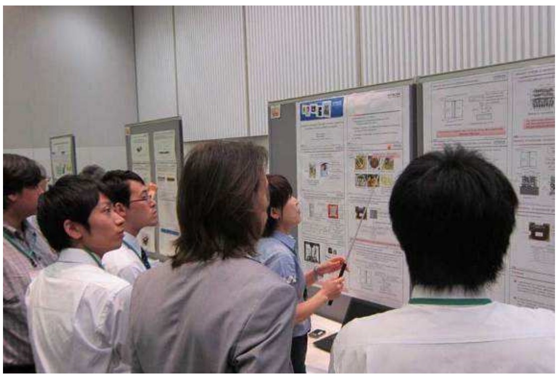


Fig. 5. Snap shot at the SS Session.

Fig. 6. Group photo of Workshop lectures with audiences.

Table 4. Lectures in workshop APIANS.

Speaker	Affiliation	Title
S. A. Boggs	Univ. Connecticut, USA	The application of computational methods to the design of dielectric materials and systems
M. Unge	ABB, Sweden	First principle simulations of electronic structure of polymer dielectrics
T. Takada	Tokyo City Univ., Japan	Determination of charge-trapping sites in saturated and aromatic polymers by quantum chemical calculation
S. Le Roy	Univ. Toulouse, France	Modeling charge transport and storage in polymeric insulating materials: numerical analysis, optimization and validation
D. Cubero	Univ. Sevilla, Spain	Numerical simulation methods to model electron trapping and transport in polyethylene at the molecular level

with the opportunity to meet other researchers from the world. More recently, links between researchers from industry and academia (including students) has become increasingly important. From this point of view, we planned another special session, named the “Sun-Shine Session,” to introduce industry R&D topics to academics. Fig. 5 shows a snapshot taken during the session. It is believed that the Sun-Shine Session was helpful as it fostered mutual understanding among researchers in industry and academia in the field of electrical insulation materials.

The symposium also conducted two special events. One was a workshop on numerical computation called APIANS, which stands for “Analysis for Polymeric Insulating Materials Using Advanced Numerical Simulation.” After an introduction from the Chair (Prof. T. Tanaka of Waseda University), several research topics, such as band energy structures, charge storage and transportation, as well as conformational structure analysis were presented (the topics are listed in Table 4). The workshop room was heavily crowded, such that standing room for the participants was insufficient.

The other special event held during the symposium was a session for space charge measurement technologies. The broad HVDC power network is moving forward with full-scale implementation, especially in Europe. The space charge distribution with the pulsed electro-acoustic (PEA) method has received much attention as a means of estimating the HVDC stress on insulating materials. This special session introduced the advanced technique for measuring the space charge distribution in insulating materials using the PEA method.

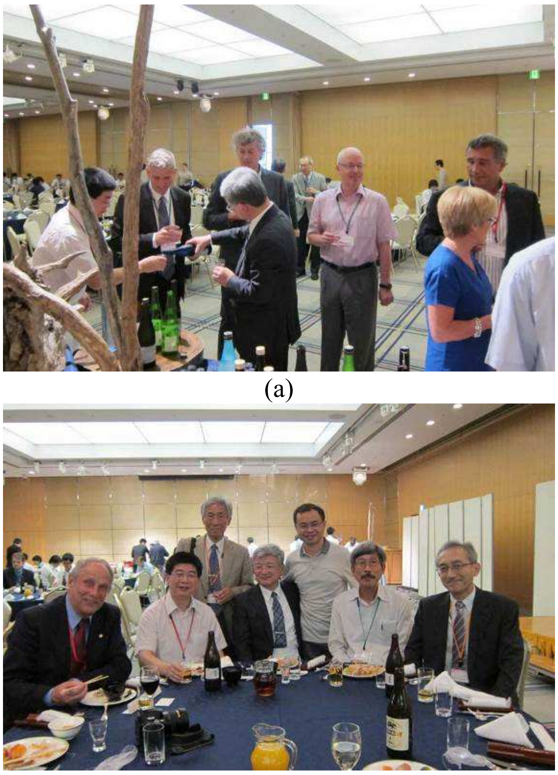
Fig. 7. Snapshot at the PEA tutorial program.

Table 5. List of PEA systems introduced in the PEA demonstration session with corresponding speakers.

Speaker	Affiliation	Title
Y. Murakami	Toyohashi Univ. Tech., Japan	Space charge measurement system equipped with a function to measure acoustic properties
K. Kumaoka	Tokyo City Univ., Japan	Ultra high resolution PEA
T. Kato	Tokyo City Univ., Japan	Simultaneous measurement PEA system
N. Hozumi	Toyohashi Univ. Tech., Japan	Space charge measurement for full size cable by pulse electroacoustic method
K. Horiguchi	Tokyo City Univ., Japan	Portable mini PEA
K. Abe	NICT, Japan	Normal PEA
K. Abe	NICT, Japan	Wire cable PEA
M. Fukuma	Matsue Nat. College of Tech., Japan	Space charge measurement for thick sample in PEA method

Fig. 8. Snapshot at the PEA demonstration session.

Fig. 9. Snapshot at the technical tour.



(a)

(b)

Fig. 10. Snapshot at the banquet.

1) Special oral presentations were held during the symposium, including keynote lectures.
2) A practical tutorial program was held which focused on the basics of space charge measurement using a standard measurement system. Participants learned about the conventional PEA system, the step-by-step process of measurement and calibration, and issues regarding compliance with the IEC Technical Specifications (IEC/TS 62758) procedures (Fig. 7).
3) Japanese researchers also held a demonstration session focusing on advanced measurement systems. Eight types of state-of-the-art PEA systems were showcased and audiences had the chance to learn how they work. Table 5 lists the systems and the names of the presenters, and Fig. 8 shows a snapshot from the event.

Fig. 11. Stick drum show at the banquet.

The local organizing committee arranged a technical tour to the Higashi Niigata Thermal Power Station, Tohoku Electric Power Co., Inc., which increased the station's total capacity to 4600 MW by the first large CCGT project in Japan (Fig. 9). The tour also visited NAMICS Corporation, a company that produces both conductive and insulating systems for electronic components and systems. Attendees of the tour also visited Imayotsukasa Syuzo Sake Brewery to become acquainted with Japanese culture. As it is well known, Niigata City is proud of its variety of wonderful sakes and cuisine, such as seafood nurtured from the Sea of Japan.

The local committee also invited all conference participants to the banquet and award ceremony. A traditional stick drum show and sake tasting event during the banquet was held, which encouraged socialization among the researchers (Figs. 10 and 11).

During the conference, the International Advisory Committee of the ISEIM 2014 met to summarize the status and preparations of the conference. After a successful meeting, it was decided that the next ISEIM would be held in Toyohashi City, Japan in 2017. We hope that all the participants and their families enjoyed a delightful time filled with friendship and kindness. The organizing committee is proud to have had the chance to organize this symposium.

Finally, we would like to sincerely thank all of the participants and members of the organizing committee for their contribution to the symposium. We also would like to express our sincere appreciation to all the supporting members of the symposium for their contributions. We hope all the participants return to Japan in 2017.

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International Conference on Electrical Engineering (ICEE 2014)

International Conference on Electrical Engineering (ICEE 2014) was successfully held at Ramada Plaza Jeju Hotel, Jeju, Korea from June 15 to 19, 2014.

ICEE is hosted by the Korean Institute of Electrical Engineers (KIEE), the Institute of Electrical Engineers of Japan (IEEJ), Chinese Society for Electrical Engineering (CSEE), and the Hong Kong Institution of Engineers (HKIE). ICEE aims to provide a forum for sharing knowledge, experience and creative ideas among international electrical engineers with focus on Asia, and to contribute to technical development in electrical engineering. The 20th ICEE has been expanded since its first opening in 1995 by Republic of Korea, Japan, China and Hong Kong.

With the theme *"Sharing Solutions for Secure and Sustainable Energy"*, ICEE 2014 was well attended by 696 delegates from Korea (444), Japan (165), China (45) , Hong Kong (18), Thailand (12) and some other overseas countries (14) (Table 1). Total 545 technical papers were submitted (Table 2). There were 549 presentations, 4 Keynote speeches, 8 Oral sessions (227 papers), 2 Industry sessions (166 papers), 2 Poster sessions (152 papers) and 4 Panel sessions.

In the opening ceremony on June 16, 2014, Dr. Ho-Yong Kim, Conference Chairperson of ICEE 2014, President of KIEE made his greeting speech (Fig.1). After the opening ceremony, 4 keynote speeches were given by Prof. Hee Jun Kim, Prof. Kouhei Ohnishi, Mr. Xiaochen Wu, Ir Prof. Ching Chuen Chan and Ir Dr. Fuk Cheung Chan (Table 3, Fig.2 - 6).

Table 1 Number of participants from each country.

No	Country	No. of participants
1	Korea	444
2	Japan	165
3	China	45
4	Hong Kong	18
5	Thailand	12
6	Indonesia	2
	Russia	2
7	Other countries	10
	Total	696

Table 2 Number of **presentations.**

Sessions	**Number of presentations**
Keynote	4
Oral	227
Industry	166
Poster	152
Total	549

Fig.1 Dr. Ho-Yong Kim gave greeting speech at the opening ceremony.

Table 3 Presenters and titles of keynote speeches.

No	Name of Speaker	Title of Presentation
1	Prof. Hee Jun Kim (Hanyang University, Korea)	The Technology Trend of LED Drivers in Korea
2	Prof. Kouhei Ohnishi (Keio University, Japan)	A New Challenge for Future Technology
3	Mr. Xiaochen Wu (China Southern Power Grid Corporation, China)	China Power System Stability Control Technology: Development and Prospect
4	Ir Prof. Ching Chuen Chan and Ir Dr. Fuk Cheung Chan (The Hong Kong Institution of Engineers, Hong Kong)	Renaissance and Power Engineering Challenges

Fig.2 Prof. H. J. Kim at his keynote speech.

Fig.3 Prof. Ohnishi at his keynote speech.

Fig.4 Mr. Wu at his keynote speech.

Fig.5 Ir Prof. C. C. Chan at his keynote speech.

Fig.6 Ir Dr. F. C. Chan at his keynote speech.

In the oral and poster sessions, technical presentation and discussions were made for some separated topics, such as *Electric Power Engineering, Electric Machinery and Power Electronics*, *Electrophysics & Applications*, *Information and Control*, *Smart Grid* and other related areas (Fig. 7).
The Special Sessions were organized for enhancing the technical programs with respect to certain topics and areas not included in the main topics. Titles of the 6 special sessions are shown in Table 4.
ICEE 2014 presented the industry session for sharing the recent advances in R&D and the "real-life" experiences by industry participants and field engineers. By focusing on the more practical side of relevant technologies this Session offered a unique opportunity for exchanging ideas and networking amongst a broad spectrum of engineers from the industry, academia and government sectors (Fig. 8).
As the panel discussions, 4 important themes were prepared and active and meaningful discussions were done during the limited time (Table 5).

Fig.7 A view of oral session.

Welcome reception, banquet and technical excursion were also arranged as the social events of ICEE 2014. Banquet was scheduled in the evening of June 17, 2014 at Grand ballroom, Ramada Plaza Jeju Hotel.

Table 4 Titles of special sessions

No	Title of special discussion
1	Optimal Control, Operation, and Planning for Distributed Generations
2	International standardization for transmission & distribution of East Asia
3	Wind energy Grid-Adaptive Technology Ⅰ
4	Wind energy Grid-Adaptive Technology Ⅱ
5	Wind energy Grid-Adaptive Technology Ⅲ
6	Decentralized Technologies for Smart Grid

Table 5 Titles of panel discussions

No	Title of panel discussion
1	Power System Wide Area Monitoring, Protection and Control
2	Renewable Energy Integration
3	East-Asia Super Grid
4	Distributed Energy Resources and Demand Response

Fig.8 A view of industry session.

At the opening of banquet, the 20th anniversary of ICEE was celebrated by cutting of the annicersary cake. The next conference, ICEE 2015 was announced to be held in Hong Kong. Dr. Ho-Yong Kim, the Chairman of Local Organizing Committee of ICEE 2014, past the flag of ICEE to Ir. Raymond K S Chan, the representative of the host of ICEE 2015 (Fig.10).

Fig.9 Cutting of the 20th anniversary cake at the opening of banquet.

Fig.10 Dr. Ho-Yong Kim (right) past the flag of ICEE to Ir. Raymond K S Chan (left).

Fig.11 A view of banquet.

By EINA TF

EINA TF gratefully acknowledges the contribution of Prof. Byongjun Lee of Korea University, the Chairman of the Local Organizing Committee of ICEE 2014, for this article.

International Conference on Condition Monitoring and Diagnosis (CMD 2014)

The 5th International Conference on Condition Monitoring and Diagnosis 2014 (CMD 2014) was convened at the Ramada Plaza Jeju Hotel from September 21 (Sunday) to 25 (Thursday), 2014.

Since its launch in 2005 and an inaugural conference held in Changwon in 2006, the CMD is an integrated gathering of the ACEID first held in Korea and the ICMEP first held in China. The Conference aims to share the up-to-date technology, expertise and information on the high voltage electric power apparatus monitoring and diagnosis across borders.

The CMD 2014 was carried out various programs including welcome reception, opening ceremony, plenary sessions, oral and poster presentations, technical tour, exhibition, gala dinner and closing ceremony in order, with over 300 delegates from 28 countries, presenting 254 exceptional papers. The CMD 2014 Organizing Committee offered a pivotal platform where all delegates can have an access to relevant technology and expertise in power engineering and can also partake in various activities to promote advancement of relevant industries at home. In particular, the advancement of power engineering in Asia was the key element for the Organizing Committee to focus on, in order to assure the spread of power engineering at the international level as well.

1. REGISTRAION

Of 307 delegates from 28 countries, 67% delegates were accounted for regular delegates with 27% student delegates (Table 1). There were 19 accompanying persons at the CMD 2014, which in turn, would suggest an accompanying person's tour program at the CMD 2016.

2. TECHNICAL PROGRAM

Technical Programs comprised of three parts: 3 plenary lectures, 15 oral sessions and 3 poster sessions. Technical programs were arranged in accordance with topics stated below. 333 abstracts were submitted and 254 abstracts were accepted. Of accepted 254 abstracts, there were 88 oral presentations and 166 poster presentations (Table 2). It is anticipated that numbers of oral presentations can be increased by having the CMD schedules extended.

1) Plenary Lectures

Plenary lectures were conducted after the Opening ceremony held on the Day 1. Dr. Uwe Schichler, Dr. Peter van der Wielen and Dr. Yong Joo Kim delivered the plenary lectures in order (Table 3 and Fig. 1 – 3).

Table 1 Number of participants from each country.

No	Country	Regular	Student	Accom person	Total
1	Australia	3			3
2	Austria	4	1	1	6
3	Brazil	1			1
4	Canada	2		1	3
5	China	40	46	6	92
6	Chinese Taipei	3			3
7	Czech Republic	2	1		3
8	Germany	8	3	1	12
9	Hong Kong	2			2
10	Hungary	1	1		2
11	India	3		1	4
12	Indonesia	2	5	1	8
13	Iran	1			1
14	Italy	1			1
15	Japan	10	7		17
16	Malaysia		1		1
17	Netherlands	4	2		6
18	Nigeria	1			1
19	Norway	1			1
20	Republic of Korea	99	13	6	118
21	Romania	1			1
22	Russian Fed.	4		1	5
23	Singapore	1			1
24	Sweden	1			1
25	Switzerland	4			4
26	Thailand	2		1	3
27	U. Arab Emirates	1			1
28	United Kingdom	3	3		6
Total		**205**	**83**	**19**	**307**

Table 2 Number of presentations for the topics.

Topics	Oral	Poster	Total
A. Rotating Machine	6	5	11
B. Transformer & Liquid Insulation	35	55	90
C. Switchgear & Gas Insulation	17	16	33
D. Cable & Solid Insulation	12	34	46
E. Overhead Line & Insulator	6	24	30
F. Substation	6	12	18
G. Other Topics	6	20	26
Total	**88**	**166**	**254**

2) Oral Session
15 Oral Presentation Sessions in three parallel rooms were delivered for 2.5 days. 88 abstracts were presented and each session was chaired by two chairs.

3) Poster Session
166 abstracts were presented at the three poster sessions. Since the poster sessions were not carried out in conjunction with oral sessions, each delegate was enabled to have enough presentation slot and level of participation was satisfactory.

4) Outstanding Student Awards
"Outstanding Student Awards" was arranged at the CMD 2014 for the first time in CMD history. This award has attracted more students to partake in the CMD 2014 and should be continued in the CMDs to come. The Awards were awarded to 13 exceptional abstract presenters with the CMD 2014 Certificate and Dolhareubang, Jeju's symbolic souvenir.

3. OFFICIAL & SOCIAL PROGRAM

1) Opening Ceremony
The opening ceremony was carried out from 9:40 on Monday September 22, emceed by Prof. Ja-Yoon Koo, the Chairman of the CMD 2014. The Opening Ceremony with delegates was celebrated with welcome and congratulatory remarks delivered by Mr. Ho Yong Kim, President of the Korean Institute of Electrical Engineers (KIEE) and Mr. Byung-Sook Kim, Executive Vice President and Chief Technology Officer of the Korea Electric Power Corporation (KEPCO).

2) Welcome Reception
The Welcome Reception between 17:00 and 18:00 on Sunday September 21, was hosted in the Grand Ballroom Foyer with over 100 delegates.

3) Technical Tour
The Technical Tour took place in the Seojeju Converter Station HVDC. 117 delegates in three sub-groups joined the tour, observing outer and inner facilities and Jeju Museum of Art, located nearby.

Fig. 1 Prof. Dr.-Ing. Uwe Schichler at plenary lecture.

Fig. 2 Dr. Peter van der Wielen at plenary lecture.

Fig. 3 Dr. Yong Joo Kim at plenary lecture.

4) Gala Dinner
The Gala Dinner emceed by Prof. Yong-June Shin with Yonsei University was hosted after the Technical Tour with 170 delegates. Starting with the remarks delivered by Prof. Ja-Yoon Koo, congratulatory and toasting remarks were also delivered by Prof. Suwarno (CMD Chiarman, Indonesia) and Prof. Shengtao Li (CMD 2016 Chairman, China). Hyosung Corporation, the sponsor for the Gala Dinner was

Table 3 Presenters and titles of plenary lectures.

No	Name of Speaker	Title of Presentation
1	Prof. Dr.-Ing. Uwe Schichler (Graz University of Technology, Austria)	Condition Monitoring on Gas-Insulated Systems
2	Dr. Peter van der Wielen (DNV GL, Netherlands)	The Need for Testing, Diagnostics and Failure Investigations of Power Cables in a Smart Grid Era
3	Dr. Yong Joo Kim (Korea Electrotechnology Research Institute (KERI), Republic of Korea)	A Novel On-Line Insulation Diagnosis Technique for Large Rotating Machine

Fig. 4 Discussion at oral session.

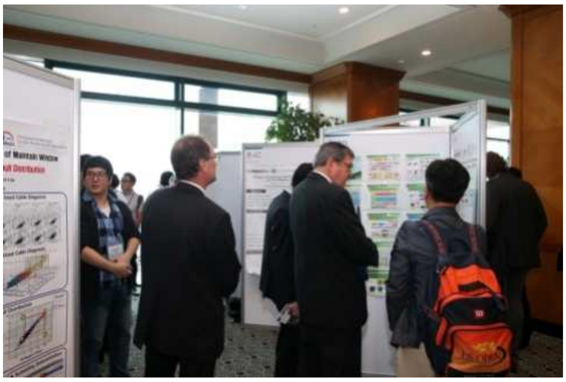

Fig. 5 A view of poster session.

Fig. 6 Outstanding Student Awards ceremony.

Fig. 7 Prof. Ja-Yoon Koo at Opening Ceremony.

represented by Mr. Jung-Bae Kim with promotional video clip and presentation. Western Course dinner was served with delightful band play, performed by “Carnival Sound,” a dialect band based in Jeju.

Fig. 8 Technical tour to the Seojeju Converter Station HVDC.

Fig. 9 A view of the Gala Dinner.

Fig. 10 A view of the Gala Dinner.

Fig. 11 Delightful band play at the banquet.

5) Closing Ceremony
The Closing Ceremony, emceed by Prof. Bang Yook Lee (Hanyang University), had the CMD 2014 Conference Report, Closing addresses and

Outstanding Student Award Ceremony. With the Closing Ceremony, the official programs of the CMD 2014 were successfully completed.

4. IAC MEETING

On Monday September 22, the International Advisory Committee (IAC) Meeting was conducted in order to review the Conference Report of the CMD 2014 and select the venue for the CMD 2018. Perth, Australia was selected as the venue for the CMD 2018 with unanimous approval. International Conference on Electrical Engineering (ICEE 2014) was successfully held at Ramada Plaza Jeju Hotel, Jeju, Korea from June 15 to 19, 2014.

Fig. 12 Members at IAC Meeting.

5. SPONSOR & EXHIBITION

5 companies sponsored the CMD 2014 and 4 companies partook in the Exhibition. Coffee breaks were organized in the same place where those booths were located and in turn, all delegates had a chance to join the Exhibition in and around the Conference.

Fig. 13 A view of the Exhibition.

Prof. Bang Wook Lee
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CMD 2014 Local Organizing Committee
Email: bangwook@hanyang.ac.kr
Tel: +82-31-400-5665
Website: www.cmd2014.org

Fig. 14 Group photo of CMD 2014.

International Conference to be held in Asia

ACED 2014 (Asian Conference on Electrical Discharge)

Dates: December 8-10, 2014
Venue: The Narai Hotel, Bangkok, Thailand
Organized by:
Department of Electrical Engineering, Faculty of Engineering, Chulalongkorn University
Co-organized by:
The Center of Excellence in Power Technology (CEPT), Chulalongkorn University
Conference chair:
Komsan Petcharaks, Chulalongkorn University

The 17th Asian Conference on Electrical Discharge (ACED 2014) will be held at Bangkok, Thailand, on December 8-10, 2014. This is the 17th conference of a series that had its last venues in Johor Bahru, Malaysia (2012), Xi'an, China (2010), Bandung, Indonesia (2008), Hokkaido, Japan (2006), Shenzhen, China (2004), Seoul, Korea (2002), Kyoto, Japan (2000), Bandung, Indonesia (1998), Bangkok, Thailand (1996), Xi'an, China (1994), Oita, Japan (1993) and Singapore (1992). The purpose of this conference is intended to provide a forum for researchers, scientists and engineers to exchange ideas and discuss recent progress in properties, phenomena and applications of electrical discharges. The organizing committee cordially invites you to participate in the conference.

Conference Topics:

- Elementary processes and transport phenomena of electric charges
- Corona, spark, surface discharge, high-pressure glow, and high-frequency discharge
- Lightning discharge phenomena and its measurement
- Pulsed power source and technology
- Plasma generation and diagnostic technology
- Application of electrical discharge and plasma
- Partial discharge phenomena and measurement
- Space charge, dielectric measurement and their applications
- Electromagnetic fields, measurement, and environmental effects
- Electrical insulation diagnostics, on-line monitoring, measurements, testing techniques and quality assurance
- Intelligent technology and system in HV engineering
- Other related issues

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http://www.ee.eng.chula.ac.th/aced2014/index.html

ICEE 2015 (International Conference on Electrical Engineering)

Dates: July 5-9, 2015
Venue: Hong Kong
Organized by:
The Hong Kong Institution of Engineers (HKIE)
Co-organized by:
Chinese Society for Electrical Engineering (CSEE)
The Institute of Electrical Engineers of Japan (IEEJ)
The Korean Institute of Electrical Engineers (KIEE)

The International Conference on Electrical Engineering (ICEE) aims to be a premium forum for sharing information, creative ideas, expert knowledge and experience among electrical engineers of the world. Since 1995, ICEE has been successfully held once a year. The Hong Kong Institution of engineers (HKIE) is pleased to announce ICEE 2015 will be held from 5 to 9 July 2015 in Hong Kong. The theme of the ICEE 2015 is "Sustainable Electrical Engineering to 3rd Industrial Revolution". We shall also invite Prof. Venkatesh Naratanamurti of Harvard University as our keynote speaker. It is a great pleasure for the HKIE, together with co-organisers, the Chinese Society for Electrical Engineering (CSEE), The Institute of Electrical Engineers of Japan (IEEJ) and The Korean Institute of Electrical Engineers (KIEE), to invite potential authors to submit quality papers to be referred in the following areas.

Conference Topics:

- Power Systems
- Power Systems and Information Technology
- Energy and Environment
- Electrical Transportation Systems
- Power Electronics, Motor Drives & Industrial Applications
- Sensors, Micro-machines and Robotics
- Fundamentals, Materials & Education
- Other Related Areas

Important Dates:

Abstract Submission:	Dec. 31, 2014
Notification of Abstract Acceptance:	Feb. 2, 2015
Full Paper Submission:	Apr.1, 2015
Notification of Full Paper Acceptance:	Mar. 4, 2015
Author/Pre-Registration:	Jun. 1, 2015

ICEE 2015 Secretariat:
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URL: http://www.hkie.org.hk/icee2015

ICPADM 2015 (International Conference on the Properties and Applications of Dielectric Materials)

Dates: July 19-22, 2015
Venue: University of New South Wales (UNSW Australia), Sydney, Australia
Organized by: UNSW Australia and IEEE-DEIS NSW Chapter
Sponsored by: IEEE DEIS
Supported by: IEEE DEIS, UNSW Australia, IEEE NSW, CIGRE AP-D1
Co-chairs:
Toan Phung, University of UNSW (Australia)
Trevor Blackburn, University of UNSW (Australia)
URL: www.icpadm2015.org

The ICPADM is fully sponsored by the IEEE Dielectrics and Electrical Insulation Society. This triennial Conference, established since 1985, is the premier insulation and dielectric materials forum for Asia. Recent ICPADM venues have included India, China, Indonesia, and Japan. The 2015 Conference will be the eleventh ICPADM and will be held at the University of New South Wales (UNSW) in Sydney, Australia, from July 19-22, 2015.

The ICPADM is a conference combining fundamental research and application practice in dielectrics covering the basic dielectric physics and the general areas of electrical insulation in power system equipment and components, monitoring and diagnosis of insulation degradation, insulation for EHV AC and HVDC systems, ageing and life expectancy of insulation, dielectric phenomena and applications, partial discharges, electrical and water treeing and surface tracking, electrical conduction and breakdown in dielectrics, surface and interfacial phenomena, nano-technology and nano-dielectrics, space charge and its effects, new and functional dielectrics, dielectric materials for electronics and photonics, eco-friendly dielectrics, bio-dielectrics, dielectrics for superconducting applications, new diagnostic applications, modelling and simulation of insulation systems, etc.

Important Dates:

Receipt of abstract:	Nov. 3, 2014
Provisional acceptance notification:	Jan. 12, 2015
Receipt of full papers:	Mar. 12, 2015
Notification of final acceptance:	May 5, 2015

ICPADM 2015 Secretariat:
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E-mail: info@icpadm2015.org

International HVDC Conference

Dates: September 14 – 16, 2015
Venue: Korea International Exhibition Center, Seoul, Korea
Co-Organized by:
Korea Electrical Manufacturing Association
CIGRE Korea National Committee
Supported by:
Institute of Electrical Engineering of Japan
Korea Electric Power Corporation
Chair: Yong Joo Kim, KERI, Korea
URL: www.hvdc2015.org

Nowadays, the global projects and researches in HVDC are very actively planned and launched especially in EU and China. Promoting the current technical and policy making issues, a lot of discussion and meetings for HVDC have been challenged for the new perspective in HVDC world. However, three main topics such as HVDC Application in Power Grid, HVDC Power Converter Station and HVDC Insulation and Dielectrics are discussed separately in one way or another. Therefore, we have been spending the enormous efforts to grasp the total strategic solutions and technical information on HVDC projects. In this context, International HVDC Conference has been organized to provide the collective strategic and technical information for the policy making staffs and technical engineers all together in the major three topics - Power Grid, Power Converter and Insulation -for HVDC era.

Main/Sub Topics
· HVDC Application on Power Grid
· HVDC Power Converter Station
· HVDC Insulation and Dielectrics
- Nano Composite Insulation Materials for HVDC Application
- Space Charge Phenomena under HVDC Environment
- Electromagnetic Design on HVDC Power Equipments
- Dynamic Thermal Characteristic for HVDC Insulation Materials
- Commissioning Test and Health Index Criteria for HVDC Power System
- HVDC Insulation Coordination

· Special Session: CMD (Condition Monitoring & Diagnosis) on HVDC

Important Dates:

Abstract Submission:	Feb. 28, 2015
Notification of Abstract Acceptance:	Mar. 31, 2015
Full Paper Submission:	May 31, 2015

The International CMD Workshop will be held in conjunction with the International HVDC Conference on Sept. 16 - Sept. 17, 2015.

China Corner

Multi-Terminal HVDC Flexible Transmission and Insulation Technology in China

Prof. Shengtao Li
Xi'an Jiaotong Univ.
Xi'an China

1. Overall

With the development of ultrahigh voltage (UHV) AC and high voltage direct current (HVDC) power transmission in China, the large scale power grid construction becomes prevalent in recent years. However, these significant developments require large amount of traditional power energy supply such as coal, fossil oil and hydro-energy, resulting in the increase of the power energy loss and environmental pollution. In order to rapidly develop the renewable energy resources such as wind and solar energy that can be used in power gird, new power generation and transmission technologies are needed to develop in China. With the development of the distributed power generation and the smart power gird technology, HVDC flexible transmission technology provides a new approach to solve the non-synchronous AC system interconnection and supply power to the remote passive loads.

HVDC flexible transmission uses the technology of Voltage Source Converter based HVDC (VSC-HVDC). HVDC flexible transmission system is quite different from the conventional thyristor based converter HVDC transmission due to the use of Insulated Gate Bipolar Translator (IGBT) valves based converter and pulse width modulation (PWM). This difference in operation makes HVDC flexible transmission a number of potential advantages over the classic HVDC. The multi-terminal HVDC flexible transmission has attracted much attention and is promising to replace the conventional HVDC flexible transmission in the near future. Chinese researchers focus on the HVDC flexible transmission system and have spent much effort on it.

2. Multi-Terminal HVDC Flexible Transmission Engineering

2.1 HVDC Flexible Transmission Technology

Figure 1 shows the schematic diagram of typical two terminal HVDC flexible transmission system. The terminal converter stations adopt VSC structures, and consist of converter station, converter transformer, commutation reactor and AC filter parts. Through effective controlling of the VSC, it can realize the active power transfer between two AC active grids. At the same time, each VSC at the two ends can also regulate their absorbed or emitted imaginary power, compensating the imaginary power in the AC systems. HVDC flexible transmission is a kind of new type DC transmission system with the rapid adjustment and more flexible controlled variable.

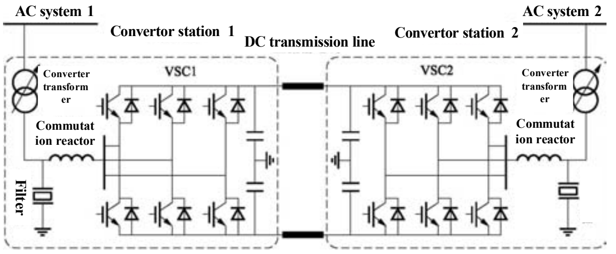

Figure 1. Two terminal HVDC flexible transmission system structure

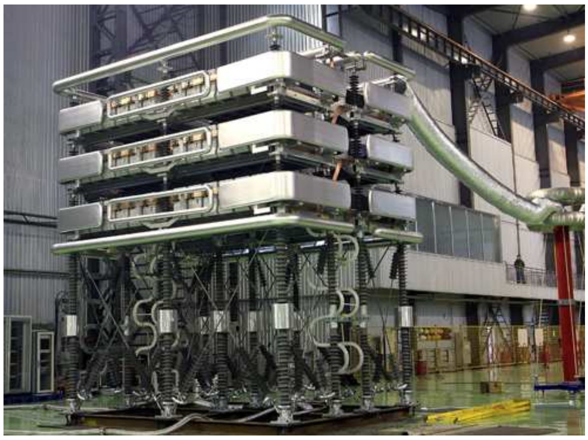

Figure 2. The converter valve tower of HVDC flexible transmission

Figure 2 shows the ±320kV/1000MW converter valve tower used in HVDC flexible transmission. It was designed and developed by the intelligent institute of state grid in China.

The converter stations in both ends of the HVDC flexible transmission system adopt Modular Multilevel Converter (MMC) structure, voltage source inverter and the step wave modulation (SWM) technology. Compared with the traditional HVDC transmission, the technical advantages are presented below.

1) HVDC flexible transmission system uses the full-controlled semiconductor devices IGBT. It does not need the commutation voltage provided by the external power grid. The receiver part can be a passive grid, overcoming the inherent defects of traditional DC transmission. It is possible for this technology to provide power supply by DC power transmission to long distance isolated load (isolated island).
2) It is useful for quickly controlling the active and reactive power, respectively.
3) It is convenient for power reversal controlling. When carrying out the power reversal in HVDC flexible system, you just need to change the direction of the DC current instead of changing the polarity of the DC voltage.

4) The power transmission ability is enhanced and the transmission energy loss is reduced in HVDC flexible transmission system.

HVDC flexible transmission system has potential applications in many fields. Fox example, it is used in the renewable energy grid system, including the solar power and photovoltaic power generations. It is also benefit for power supply to remote mountainous areas and offshore isolated islands.

The first demonstration project of HVDC flexible transmission system in China is Shanghai Nanhui HVDC flexible project (two terminal HVDC flexible transmission system based on wind power), which is also the first HVDC flexible transmission project with independent intellectual property rights in Asia. It was put into formal operation in 2011. The transmission capacity of this system is 20,000 kW, and the DC voltage is ±30 kV.

2.2 Multi-Terminal HVDC Flexible Transmission Projects

The characteristics of the Multi-Terminal HVDC Flexible Transmission system are that the power load center cities can be powered by the multiple sites of wind and solar energy, geothermal energy and other clean energy through a high-capacity long-distance transmission channel based on HVDC flexible transmission technology. It provides an effective solution to renewable power integration, power supply for big city and isolated islands.

Recent years, the HVDC flexible transmission technology has been rapidly developed in China. Besides the Nanhui HVDC flexible project, other multi-terminal HVDC flexible transmission systems have been constructed in China.

Zhoushan Multi-Terminal HVDC Flexible Transmission project is the first five terminal HVDC flexible transmission system based on wind power in the world. The project consists of four converter stations, which are Dinghai, Daishan, Qushan, Yangshan and Sijiao stations with power capacities of 400,000 kW, 300,000 kW, 100,000 kW, 100,000 kW and 100,000 kW, respectively, as shown in figure 3. The DC voltage is ±200 kV. The length of DC cable transmission line is 140.4 km. There are three wind power stations, including Dinghai, Qushan, and Sijiao stations.

Figure 3. Geographic and electrical connection graph of Zhoushan island five terminal HVDC flexible transmission system

The modular multilevel converter (MMC) was used in Zhoushan multi-terminal HVDC flexible transmission project. Its topology structure is the parallel radiation grid. The system can provide continuous operation by this topology structure if one of the converter stations stops running. It has strong reliability and stable operation. This project can ensure the reliable power supply of the islands in case the malfunction occurred in any converter stations.

Figure 4. Geographic and electrical connection graph of Nanao island three terminal HVDC flexible transmission system

Figure 5. The laying of submarine cable in Nanao three terminal HVDC flexible transmission project

Another multi-terminal HVDC flexible transmission project is the Nanao three-terminal HVDC flexible project, which is settled in Nanao Island, Shantou city, Guangdong province. The designed power capacity is 200,000kW, and the DC voltage is ±160 kV. The Naoao multi-terminal HVDC flexible transmission project has built three converter stations, including Chenghai Sucheng 220 kV, Jinniu 110 kV and Qingao 110 kV stations, as shown in figure 4. The wind power stations are located in Niutouling, Yunao, and Qingao. The constructed length of DC cable transmission line is 40.7 km. This project also used MMC technique to ensure the reliable power supply of the island. Figure 5 shows the laying of submarine cable in this project.

2.3 Key techniques of multi-terminal HVDC Flexible Transmission engineering

In order to connect the multiple wind, solar and other power stations or many converter stations, and construct the flexible reliable power gird, it is necessary to consider some key techniques to develop HVDC flexible transmission engineering, such as power electronic technology, control and protection technology of power system and some testing techniques.

One of the key techniques is the design and application of modular multilevel converter technique. The topological structures of the MMC are various, which directly influence the reliability and flexibility of the transmission systems.

The operating stability of many parallel inverters is another key point in multi-terminal HVDC flexible transmission system. It needs pay much attention to the power allocation and mode of parallel operation among the inverters.

It is also crucial to design and apply the control, protection and testing technology of the multi-terminal HVDC flexible transmission system. The operation mode of the multi-terminal HVDC flexible transmission system will be very flexible and diverse (i.e. it is diversity to keep the balance of power rather than the uniqueness in two terminal system). The technical key points include the balance of power among the multi-terminals under operation, the stabilization of DC voltage and the quick adjustment, mode transition and rebalancing of the multi-terminals under the condition of fault disturbance.

3. Electrical insulation technology

The electrical insulation technology in the multi-terminal HVDC flexible transmission system presents some new problems and challenges. The insulating materials could be subjected to the electrical and mechanical stresses that are brought by polarity reversal and multi-fields (AC/DC, AC/impulse and DC/impulse electric fields). In addition, the electrical insulation technology of DC cable is a key issue.

In converter station, oil-paper insulation system used in the converter transformer is usually subjected to the effect of multi-fields. This can significantly influence the space charge, aging and breakdown properties of oil-paper insulation. Much attention should be paid to the electrical stress and space charge accumulation in the oil-paper insulation.

The electrical insulation issues of DC arrester in converter station include the insulation coordination between power equipments, the DC insulation level, the nonlinearity and impulse aging properties of DC metal oxide arrester. The surface charging and flashover in DC bushing and GIS insulation also should be considered.

Currently, the cross linked polyethylene (XLPE) cable is widely used in HVDC flexible transmission system. The space charge behavior, aging, degradation (electric treeing and water treeing) and breakdown performances become more important under DC conditions. The conductivity of cable insulation changes with temperature. The surface electric field gradually increases when the load increases significantly. Therefore, the maximum load that DC cable can be endured should be less than the maximum surface electric field. The insulation technology in DC cable not only could consider the highest working temperature, but also should consider the temperature distribution in XLPE.

The space charge accumulation in XLPE can lead to the distortion of electrical field within the insulating material, which can cause the electric breakdown in certain conditions. Typical PEA technique was widely used to investigate the space charge properties in insulating materials. The space charge characteristics are influenced by the microstructure of materials, charge injection from electrode/insulation interface and charge transport properties in materials. Generally speaking, the homocharge accumulation near the electrodes can reduce the injected filed and decrease the space charge accumulation.

Electric treeing or water treeing are important factors to affect the degradation properties of submarine cable. Under moisture circumstances, the cable is easy to initiate electric trees due to the local electric field concentration. With the increase of time, the trees can gradually grow through the insulating material to cause breakdown. Therefore, it is necessary to investigate and restrict the electric or water tree growth in XLPE cable insulation.

4. Conclusion

The HVDC flexible transmission, especially for multi-terminal HVDC flexible transmission system in China have been introduced. HVDC flexible transmission systems have potential application in the renewable energy grid system, and in power supply to remote mountainous areas and offshore isolated islands. Zhoushan island five-terminal HVDC flexible transmission project and Nanao island three terminal HVDC flexible transmission project indicate the rapid development of HVDC flexible transmission technology in China.

The modular multilevel converter technique, operating stability of many parallel inverters, and the control, protection and testing technology play key parts on multi-terminal HVDC flexible transmission.

It is necessary to focus on the electrical insulation issues in the multi-terminal HVDC flexible transmission. The space charge, breakdown and aging properties of oil-paper insulation, the nonlinearity and impulse aging properties of DC metal oxide arrester, the surface charging and flashover in DC bushing and GIS insulation and the space charge behavior, aging, degradation (electric treeing and water treeing) and breakdown performance in DC cable should be considered.

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Korea Corner

Strategic Planning of CMDS for Power Equipments

Dr. Yong-Joo Kim
KERI, Korea

1. Introduction

2014 CMD (Condition Monitoring and Diagnosis) Conference (Sept.21 - 24, 2014, Jeju, Korea) and 2014 CMD Workshop (Sept. 25 - 26, 2014, Seoul, Korea) were held as the conjunctive activities not only for the utility engineers but also for the academicians. Especially in 2014 CMD Workshop - subtitled as "User Oriented Practical", KEPCO (Korea Electric Power Company), KEPRI (Korea Electric Power Research Center)-KEPCO and K-Water (Korea Water Resources Company) have presented their long term strategic planning of CMDS (Condition Monitoring and Diagnosis System) and the current issue. The brief of each company's strategic planning is introduced as follows.

2. KEPCO's Master Plan on CMDS

In 2014 CMD Workshop, KEPCO has announced the master plan for CMDS as shown in Fig.1. The company's long term plan so called "Developing Breakdown Prediction System" is extended to year 2025 including Asset Management Program. Currently KEPCO is focusing on development of real time CMDS for cable, main transformer and GIS separately. The short term plan named as "Individual Management" will be completed in year 2016.

KEPCO has also claimed that the current "Individual Management" program on CMDS has prevented 63 main transformers from failure (1999-2013) and 105 GISs from breakdown (2000-2013).

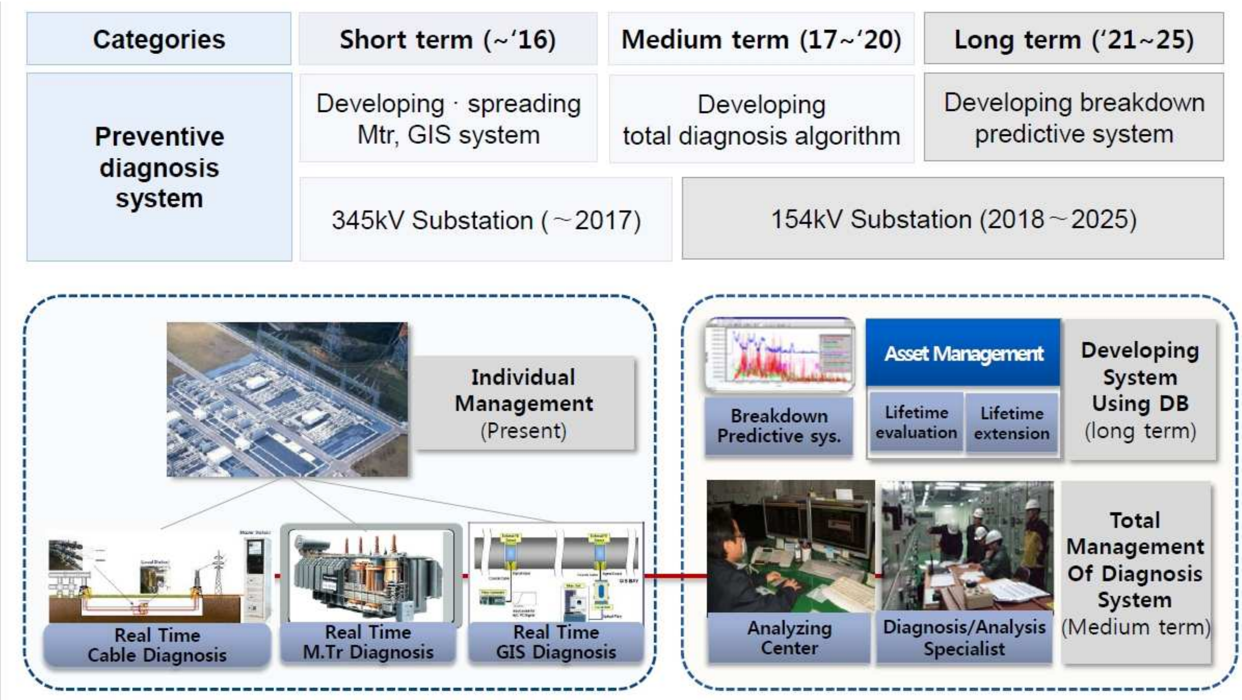

Fig.1. KEPCO's Master Plan for CMDS

3. CMDS in Ultra Supercritical Fossil Power Plant

The power generation companies in Korea have also announced the undergoing plan for Ultra Supercritical Fossil Power Plant (1,000 MW, 610/621℃, 265 kg/cm^2, efficiency 44%). As shown in Fig. 2, CMDS for the power plant is scheduled to complete its development by year 2017. The first five year's research (2010-2015) was focused on CMDS evaluation and verification, which combines electrical, mechanical and thermal aspects of the power plant. During their research program, they developed their own CMDS for the power plant without adopting any commercially available ones. And especially in vibration diagnostics, they claimed that the novel CMDS so called "Residual Pattern Recognition" scheme shows more than 90% reliability in preventing vibration problem while a commercial one shows only about 60 % level. The optimization program on the novel CMDS will continue until year 2017. During the

3rd period (2015-2017) of the development program, the operational data and user friendly interface function will be enhanced through on-site installation of the system.

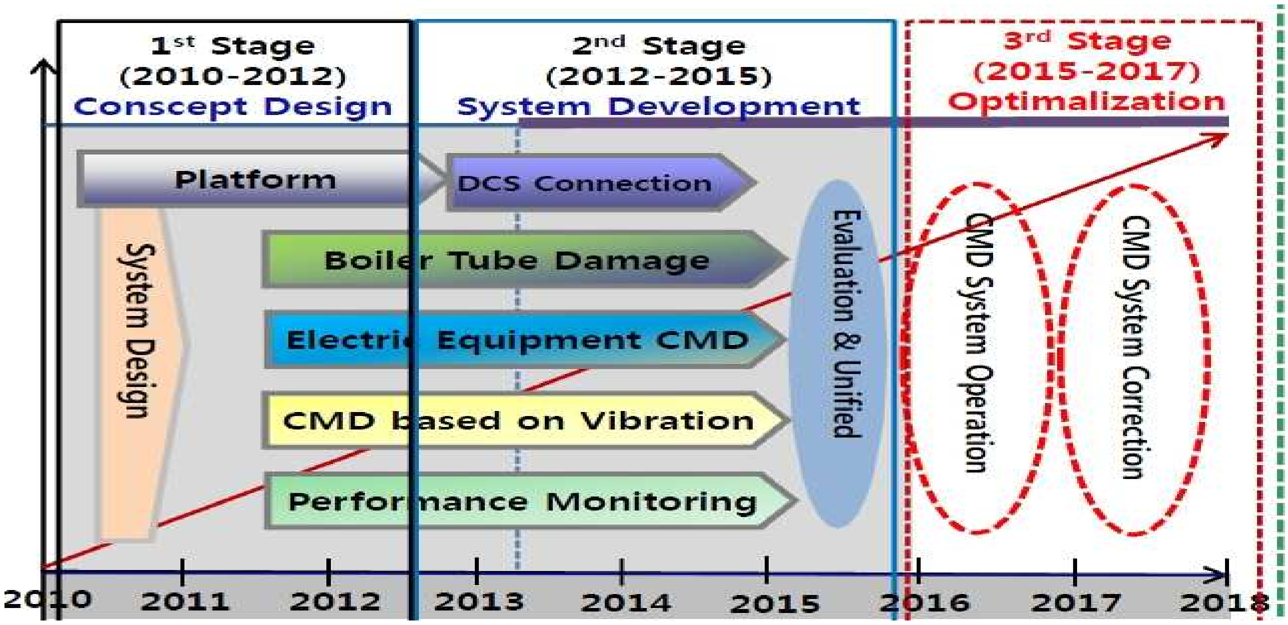

Fig.2. Development Program of CMDS on Ultra Supercritical Fossil Power Plant

4. Issue on Judgment Criteria for Insulation Health Index

K-Water presented the paper claiming the difficulties in applying judgment criteria for off-line insulation diagnosis on rotating machines and transformers (90 generators, 250 transformers and 500 motors were tested with off-line insulation diagnostic scheme) as shown in Fig. 3. For example, three Korean companies including K-Water show the different judgment criteria of insulation health on 11 kV rotating machine. However, after the intensive expert's discussion on the issue, due to the fact that the failure process of insulation system generally involved in more than 30 different mechanisms, therefore, it is very difficult to have one standard judgment criteria unless the effect of aging or failure mechanism on the specific insulation index is known. The further research on aging or failure mechanisms of insulation materials against remaining life were proposed as an international cooperation program.

Test	Character	Condition	Criterion		
			K-water	A	B
Insulation R	R[mΩ]	40℃	100↓	500↓	100↓
P.I	P.I	5kV	2.0↓	2.0↓	2.0↓
AC Current	△I1[%]	$1.25E_0$	5↑	5↑	5↑
	△I2[%]	E	12↑	-	12↑
Tanδ	$\tan\delta_0$[%]	2kV	10↑	-	-
	$\triangle\tan\delta_1$[%]	$1.25E_0$	2.5↑	2.5↑	2.5↑
	$\triangle\tan\delta_2$[%]	E	6.5↑	-	6.5↑
P.D	Qmax1	E_0	30,000↑	50,000↑	30,000↑

Fig.3. Three Different Judgment Criteria on 11 kV Rotating Machine from Three Companies

5. Perspective on Potential Insulation Diagnostic Techniques for HVDC Cable.

Professor Peter Morshuis (Delft University) has presented the perspective on potential insulation diagnostic techniques for HVDC cable in 2014 CMD Workshop. He emphasized the issues on dynamic temperature effecting electric field distribution and polarization/space charge phenomena play the major role in insulation degradation of HVDC cable. In his presentation, temperature, partial discharge trend, space charge distribution/dynamics, and polarization/depolarization current were proposed as the potential diagnostic properties. The participants also recommended the further discussion on insulation and dielectric phenomena of HVDC power equipments in 2015 CMD Workshop.

Photo: Speakers in 2014 CMD workshop (32 invited speakers and 211 participants)

6. Brief on International HVDC Conference

During 2014 CMD Workshop, KIEE and KOEMA have proposed to co-organize "International HVDC Conference" as follows. The conference has three major topics. One of them is HVDC Insulation and Dielectrics.

1) Conference Title : International HVDC Conference (www.hvdc2015.org)
2) Date: Sept. 14 – Sept. 16, 2015
3) Venue: KINTEX, Seoul, Korea
4) Main/Sub Topics
   - HVDC Application on Power Grid
   - HVDC Power Converter Station
   - HVDC Insulation and Dielectrics
     - Nano Composite Insulation Materials for HVDC Application
     - Space Charge Phenomena under HVDC Environment
     - Electromagnetic Design on HVDC Power Equipments
     - Dynamic Thermal Characteristic for HVDC Insulation Materials
     - Commissioning Test and Health Index Criteria for HVDC Power System
     - HVDC Insulation Coordination
   - Special Session: CMD (Condition Monitoring & Diagnosis) on HVDC

➢ In conjunction with International CMD Workshop (Sept. 16 - Sept. 17, 2015)

Reference

[1] Presentation materials in 2014 CMD Workshop (www.cmdworkshop.org)

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India Corner

Activities at High Voltage Laboratory, Indian Institute of Technology Bombay, Mumbai, India

Prof. S. V. Kulkarni
IIT Bombay, India

The High Voltage Laboratory at Electrical Engineering Department, IIT Bombay, was established in the year 2007 with the main objective of conducting research related to partial discharge (PD) phenomena in high voltage equipment. The department had many other laboratories in power engineering dealing with power systems, power electronics, and field computation. However, there was no high voltage research facility when the country was steadily progressing to 800 kV systems.

In Power Engineering, due to other emerging and attractive research areas such as smart grids and renewable energy, the interest of faculty and student community has been steadily dwindling for pursuing research in high voltage engineering. In this context, the development of this laboratory was a significant step forward for nurturing and supporting research activities in this very important area. Since the laboratory is mainly intended for insulation diagnostics and characterization, it has been named as 'Insulation Diagnostics Laboratory'.

Since establishment, research has been conducted in the laboratory in the following areas, viz.

1. Ultra high frequency corona phenomena
2. Characteristics of mineral oil and vegetable oils
3. Finite difference time domain method based simulations of PD initiated wave propagation
4. Nanodielectrics

This article summarises how the laboratory was conceived and developed. Details of the installed Faraday cage are given. It also highlights major research projects undertaken in last six years.

Laboratory Development and Infrastructure

The laboratory was established on the second floor of the Electrical Engineering Department in place of an old laboratory which was not in use. It was really a challenging task to build it in the midst of surrounding electronic and computational laboratories. Safety and elimination of to-and-fro interference were the topmost priorities. Designing of a suitably shielded room was also a challenging task due to space constraints.

The total size of the laboratory is approximately 11.5 x 9.0 m^2 with height of 3.2 m. Due to space constraints, it was decided to restrict the voltage level upto 100 kVrms and focus on PD research. Since impulse setup was excluded, system design considerations with regard to earthing and equivalent circuit parameters were not that demanding.

Various equipments/instruments were procured over a period of time, and they are as under:

- A high voltage transformer: 230 V/100 kV, 5 kVA continuous rating, 10 kVA for 60 minutes
- Two high voltage diodes for obtaining 140 kV DC voltage
- A coupling capacitor for PD measurement
- An AC voltage divider for measuring high voltages
- DC measuring resistor
- PD measurement system and software
- Spectrum analyzer with frequency range of 100 kHz to 6 GHz
- Insulation diagnostics analyser: 0.1 mHz to 10 kHz frequency range
- Impedance analyser (LCR meter) with frequency range of 42 Hz to 5 MHz

Designing a cost-effective Faraday cage in limited space was a formidable task. Its main design considerations and pros and cons of various options are described in the next section. The cage with the HV setup is shown in Fig. 1.

Fig. 1 High Voltage Setup

Design and Fabrication of a Faraday cage

When literature on electromagnetic shielding was surveyed, it became apparent that different metals (Al, Cu, MS) and different designs (single/double cage, metal sheets/wire mesh/expanded plate designs have been used for the purpose. The door of the cage needs to be specially designed. Interlocks have to be used for electrical safety.

A few high voltage laboratories in India (IISc Bangalore, IIT Madras, Jadavpur University, BHEL R&D, VJTI, Anna University, and Central Power Research Institute) were visited to learn from experiences of experts. Designs of Faraday cages at all these places were found to be different at least in one or two features. These visits, surveyed literature, and interactions with national/international HV experts through e-mail helped to finalize the specification of the Faraday cage which has been eventually built by using thin sheets of electrolytic grade aluminium for its walls and ceiling. Chequered aluminium plates have been used for flooring. The whole structure is built using a framework made of powder coated square MS pipes. The door is specially designed to have an overlap with the supporting frame to minimise effects of the opening. A window for observation is also available, which has been made using expandable aluminium. An interlock using a reference ground (from a separate earthing pit) is also provided in addition to a standard door interlock. The ambient interference level reduced from 18 pC to about 2 pC after the cage has been installed (Fig. 2).

The experience gained while building the Faraday cage helped in reducing the ambient interference level of a test setup of a company from about 50 pC to just 0.7 pC through a consultancy project.

Fig. 2 Faraday Cage (4 m x 5.7 m x 3 m)

Various research activities undertaken in the laboratory since its establishment are now briefly described in the following sections.

Investigations on Different Types of Mineral Oil

One of the earliest investigations carried out in the laboratory, as a part of collaborative research with an industry, involved investigative tests on different types of mineral oil (paraffinic oil, naphthenic oil, and isoparaffinic oil) to understand effects of particles and moisture on electrical discharge activities in them. The PD inception voltages for a point-plane electrode configuration have been determined as per IEC 60270 for different sizes and concentrations of copper and cellulose particles and for different moisture levels. From these experiments, it has been observed that definite relationships existed between PD inception voltages and degree of contamination for these oils.

Studies on Nano Dielectrics

A nano-dielectric is referred to as an insulating material (solid or liquid) dispersed with nano-size particles of some other suitable material. Use of nanoparticles has been found to be effective in improving select material properties of the insulation. For example, thermally conducting nanoparticles can be used to improve heat transfer properties of dielectric fluids. In turn, they offer a possibility of optimization of high voltage equipment. A few studies on using nanoparticles in mineral oil have been reported in literature.

Thermal conductivity of mineral oil can be significantly improved by using specific nanoparticles. Spherical alumina particles less than 100 nm have been used to prepare nano mineral oil. Different electrical properties, i.e., dielectric constant, breakdown strength, tan delta, and dc resistivity, have been measured to study the performance of the nanofluid. Experimental results showed that the use of a stabilizer increased the tan delta and decreased the dc resistivity of the oil although the breakdown strength improved. The study highlighted that some of the dielectric properties may be adversely affected while trying to improve thermal properties of mineral oil through nanoparticles.

Ultra-High Frequency Simulation Measurement and Analysis of Some Corona Phenomena

Corona/partial discharges may be feeble but they can grow into damaging proportions. Although the electrical method for PD detection is well-established and standardized, acoustic and ultra-high frequency (UHF) signal based techniques are being researched extensively. The UHF detection offers the possibility of online monitoring, and noise interference is lower as compared the acoustic technique. The following two investigations have been done contributing further to the existing knowledge on the subject.

A. Analysis of Frequencies Radiated by the Point-to-Plane Electrode Configuration under DC and AC Voltages

Corona/PD phenomena lead to radiation along with other effects such as light, dielectric decomposition, temperature rise, etc. Experimental setup consisting of point-plane electrode configuration has been designed with proper placement of antennas to capture radiated signals. The measurements have been used to obtain the correlation between physics of partial discharge at the electron level and the signals measured by UHF antennas [1]. Analysis was performed for DC as well as AC voltages. For DC, both positive and negative polarities are considered for the point electrode.

It has been observed that the overall strength of the signals captured from the negative discharge is stronger than that for positive polarity, on an average by about 10 dB for the given experimental setup. Furthermore, the negative corona appeared to have more uniform frequency content. Corona signals existed in a frequency range of 300 MHz to 1500 MHz. The signals received for DC positive and negative polarity have been distinct. Correlations between the physical processes and the received signals are also identified. Possible mechanisms responsible for a changing UHF pattern with increasing voltage have been explained. Analysis of signals received for an applied AC voltage and comparison with the DC cases have also been done (Fig. 3).

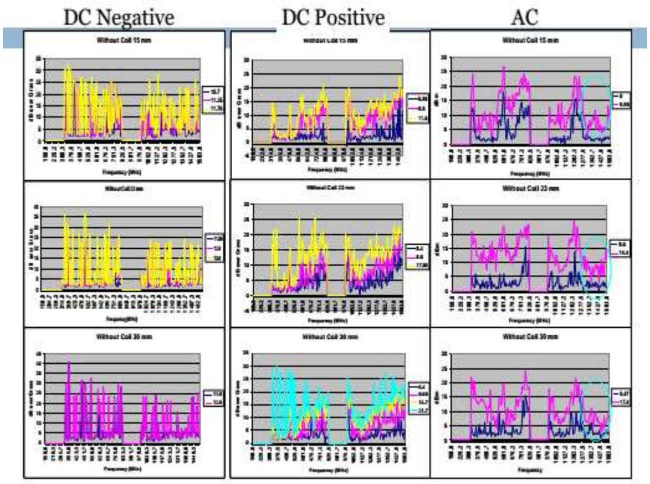

Fig. 3 Frequency spectrums due to corona [1]

B. Effect of Alternating Magnetic-Field on Point-Plane Corona

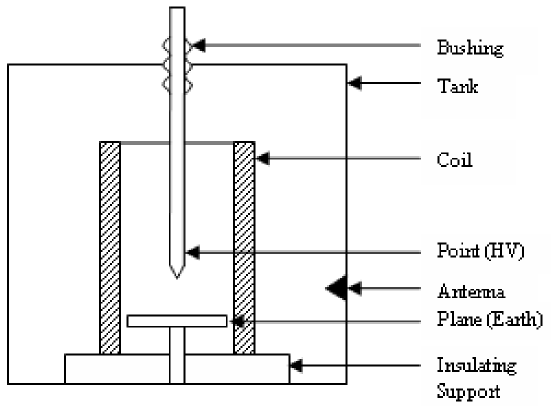

Fig. 4 Experimental Setup and its Sketch [2]

The effects of magnetic field on point-plane corona phenomena have been studied using the setup shown in Fig. 4. Experimental measurements have been backed by theoretical calculations done using a plasma physics perspective.

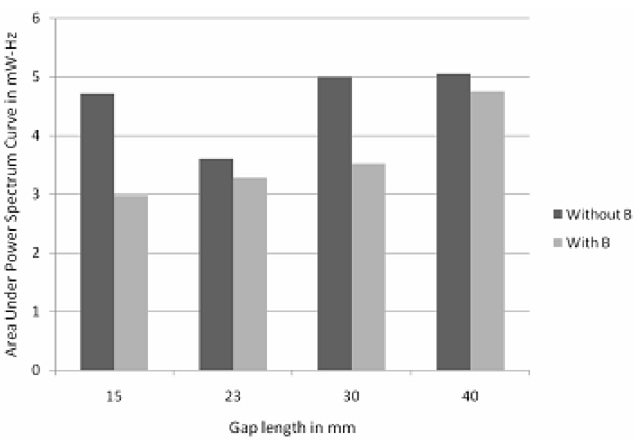

Fig. 5 Effect of magnetic field on corona [2]

The presence of an AC magnetic field has been found to have a benign effect on the ac corona [2]; its power spectral density reduced in the UHF band of 650-800 MHz in the presence of a magnetic field, as shown in Fig. 5.

Characterization of a New Vegetable Oil

Mineral oil is conventionally used in distribution and power transformers. Its main shortcoming is that it is non-biodegradable. Also, it has a low flash-point temperature. There have been significant efforts by researchers worldwide to develop natural/vegetable oils which are inherently biodegradable. Some of the vegetable oils have been commercialized and are being used as liquid insulation and coolant in transformers. In this work, a vegetable oil mostly available in Asian countries has been investigated for its application to transformers.

Any oil, for its use in transformers, should have good dielectric properties. For making the selected vegetable oil suitable for its application to transformers, the work involved concentrated on the following aspects: reduction of dielectric dissipation factor (tan delta) to an acceptable level, improvement of its flash point by using additives, assessment of its stability against oxidation and ageing processes, and evaluation of the effect of moisture on its dielectric properties. The results have been found to be encouraging.

FDTD Based Studies on PD Initiated Wave Propagation

As mentioned previously, the UHF PD detection method can be of great advantage since it can be used as an onsite and online method. It has sensitivity to PD signals and very good immunity against noise.

For locating PD sources and to determine their severity, numerical simulations are usually done to aid experimental investigations. Finite difference time domain (FDTD) technique based simulations have been done to analyze PD initiated electromagnetic wave propagation phenomena.

For simulating propagation of electro-magnetic waves from a PD source inside high voltage equipment such as a transformer, an absorbing boundary condition (ABC) is applied to the enclosure for eliminating reflections in order to study the path between the source and the sensor location. Using a perfectly matched layer (PML), ABC can be efficiently enforced [3]. The incident wave can be completely absorbed within the boundary layer by assigning complex values to material constants to make it lossy. Simulations have been done for free space first; in a subsequent study, PD propagation has been analyzed for a representative domain emulating a typical transformer structure with its core and windings. For locating a PD source, differences between the measured arrival times to the sensors are used.

Fig. 6 shows the graphical result of an FDTD simulation with a Gaussian pulse introduced at the center of the grid [3].

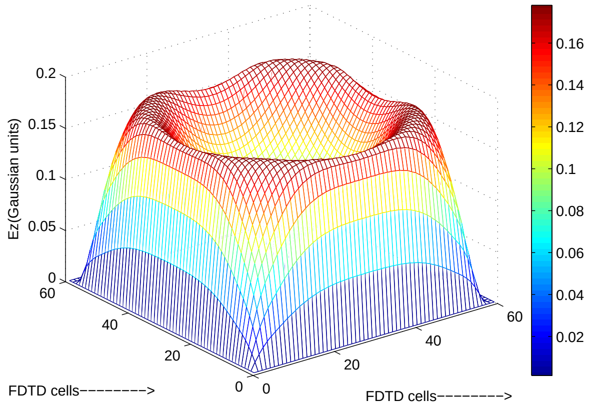

Fig. 6 FDTD based simulations [3]

Conclusions

This article has summarized the phases of development of Insulation Diagnostics Laboratory at the Electrical Engineering Department, IIT Bombay, Mumbai. Challenges in establishing the high voltage setup have been enumerated. With a cost-effective design of a Faraday cage, the ambient interference level has been substantially reduced for conducting research in PD diagnostics. Various research projects undertaken in the laboratory can be broadly classified into the following categories, viz. characterization of insulating oils, understanding physics of corona phenomena, UHF PD diagnostics, nano-dielectrics, and numerical simulations of PD initiated wave propagation phenomena. Some of the projects, which are in progress/under consideration include development of advanced instrumentation for PD measurement and study of PD phenomena in gas insulated substations.

Research activities in high voltage engineering need to be supported and nurtured given the fact that the highest transmission voltage level in many countries is now about 800 kV and some countries like India are gearing up for the 1200 kV level through research and establishment of an experimental setup. It is a difficult task to attract good students for working in this so-called traditional research area. However, new avenues such as nanodielectric materials and emerging applications in pulse power technology and biotechnology will make this field attractive in near future.

Acknowledgment

The laboratory has been established through funds given mostly by MHRD Govt of India and IIT Bombay. The credit also goes to M.Tech and PhD students who worked on various research projects; a special mention must be made of Dr. Avinash Bhangaonkar who significantly contributed to the laboratory while doing his doctoral work.

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Dr. S. V. Kulkarni is a Professor in Electrical Engineering Department, Indian Institute of Technology Bombay, India. Previously, he worked at Crompton Greaves Limited and specialized in the design and development of transformers up to 400 kV class. He has authored a book ‘Transformer Engineering: Design, Technology, and Diagnostics’, Second Edition, published by CRC Press. The author of 150 professional publications in reputed journals and conferences, he is recipient of the Young Engineer Award (2000) from the Indian National Academy of Engineering (INAE), and now he is a Fellow of INAE. He also received Career Award for Young Teacher from All India Council for Technical Education in 2001. Field Computation Laboratory and Insulation Diagnostics Laboratory have been developed by him in Electrical Engineering Department of IIT Bombay. His research interests include analysis and diagnostics of transformers, computational electromagnetics, high voltage engineering, and smart grids.

TECHNOLOGY REVIEW

New Emergence of Computer Role in Dielectrics

Toshikatsu Tanaka, Waseda University

Prof. T. Tanaka

"Dielectric Breakdown of Solids" and "Theory of Dielectrics" were published by Stanley Whitehead in 1953 and by Herbert Fröhlich in 1958, respectively. To our surprise, such theories included the modern quantum mechanics. It is generally recognized that the "theories" were completed in the middle of the 20th century. For more than half century since then, engineering problems have been solved on the basis of such theories for practical applications and materials aging. In the 1940s, during the 2nd World War, computer technology began to appear especially to calculate ballistic trajectories. Such a computer technology has been rapidly emerged in pace with the development of semiconductor active devices and memories in microelectronics. The Moore's law (1965) tells that the number of components per unit area in integrated circuits would double every year. Now we come to the era in which we cann4ot survive without computers.

In the dielectrics world, on the other hand, computer simulation has newly emerged in recent years. Its role is crucial now. Many relevant publications appeared separately, but no common understanding has been intentionally sought. Therefore, a workshop on "Computer Simulation in Polymer Dielectrics" was held in 2014 [1] to promote comprehensive survey of this emerging issue. This short article gives a bird's eye view on the recent trend in computer simulation in dielectrics including some results opened and discussed in the workshop.

Dielectric phenomena have been simulated by a variety of methods. But so far there no sufficient reviews and discussions have been made for comprehensive understanding. It is now understood from a preliminary survey that simulation works in dielectrics can be represented by the following methods:

(1) Ab initio with DFT
(2) Molecular Dynamics (Course Grained MD)
(3) Monte Carlo Simulation
(4) Cellar Automata with FEA
(5) Fractal Analysis
(6) Stochastic Analysis
(7) Direct Solution from Governing Formulae

Simulation is not actual experiments. Therefore, when we execute simulation work, we should be careful of the following two issues:

(i) Don't forget what assumption has been made in simulation in advance.
(ii) Try to predict what characteristics appear under the condition which is not experimentally realized easily.

Table 1 demonstrates the outcome from such a survey on how to solve each of representative and significant dielectric characteristics. Macroscopic simulation was major in the past, but it is now possible to make microscopic analysis. Some of the examples for microscopic analysis are ab initio and molecular dynamics simulation methods that can treat molecular levels. Ab initio simulation method becomes easy to handle, as DFT (the density functional theory) has been introduced. Polymer crystal structures can be treated in principle as for electronic states. But now physical and chemical defects, amorphous regions and even interfaces can be covered thanks to methodological innovation. Molecular dynamics simulations are popularized, as coarse-grained methods are utilized. It was used for example to clarify how interfaces are formed between polymer matrices and nanometer-sized filler particles [2]. It should be noted that some of the simulation codes are commercially available. It certainly helps much in progress in simulation of dielectric phenomena. We must recognize that unfortunately such microscopic analysis methods have some limitation on their capacity to be able to treat. So it is advisable in some cases to combine with more macroscopic simulation methods, as shown in the case of breakdown in Table 1 for example.

Charge transport is simulated via what is called "semi-microscopic models" using charge carrier drift and diffusion equations. This belongs to conventional macroscopic simulation methods in principle, but includes assumption of microscopic characteristics such as exponential trap distributions.

Treeing phenomena can be treated by cellular automata and fractal dimension [3-5]. Cellular automata are discrete, abstract computational systems that have proved useful both as general models of complexity and as more specific representations of non-linear dynamics in a variety of scientific fields. This method was utilized for tree propagation in epoxy and nanocomposite. It is necessary to determine electric field in a point of interest, which can be done with the finite element analysis (FEA). A fractal dimension is a ratio providing a statistical index of complexity comparing how detail in a pattern (strictly speaking, a fractal pattern) changes with the scale at which it is measured. It has also been characterized as a measure of the space-filling capacity of a pattern that tells how the pattern is embedded in the space; a fractal dimension does not have to be an integer. This method was used to simulate 3D treeing patterns to compare with experimental data [5].

Partial discharges can be analyzed by stochastic time lag models and Monte Carlo simulation methods [6]. FEA methods are utilized when values of electric field are necessary [3].

Table 1. Simulation Methods and Dielectric Characteristics

Dielectric Characteristics	Sub-items	Simulation Methods
Nanocomposite Materials Structures	Characteristics of Interfaces	Coarse Grained Molecular Dynamics Simulation
Band Gap Density of Electronic States Chemical and Physical States Energy Levels	Density of states for all electrons	DFT ab initio (Quantum Mechanics) Simulation
	More than 1000 carbon atoms Electronic structures of amorphous phase	Linear Scaling DFT Materials Studio: ONRTEP Module
	Amorphous phase with defects and impurities	Amorphous Cell Construction Module
	Molecular structure and energy minimization	MD Simulation with COMPASS Force Field
	Mobility edges	Percolation Theory
Electron Trapping and Transport in Polyethylene	Band edge: localized and delocalized states to include crystals, amorphous and interphases	DFT ab initio Lanczos Methods to Treat Excess Electrons
	Molecular configuration	MD Simulation
	Zero field mobility	Kubo-Greenwood Equation
Energy Levels of Trapping Sites in Non-polar, Saturated and Aromatic Polymers Space Charge	Localized states up to 1500 orbital electrons	DFT Gaussian 09 Code
	3D potential maps	MATLAB
Charge Distribution in Macroscopic Interfaces	Macroscopic model with permittivity and conductivity	Maxwell-Wagner Theory
Charge Generation, Transport and Storage	Semi-microscopic model with drift and diffusion equations	Semi-empirical Fluid Model with Assumed Exponential Distribution of Traps
	Trap-controlled transport Charge packet	Bipolar Fluid Model
Dielectric Breakdown	Phonon scattering Energy of electrons in their scattering with phonons, dipole and defects Breakdown field is inversely proportional to carrier mobility	DFPT ab initio Quantum ESPRESSO Code
	Average electron velocity by dipole scattering Energy of hot electrons in a cavity as defects	Monte Carlo simulation
Partial Discharges	Stochastic behaviors	Stochastic Time Lag Models Monte Carlo Simulation
	Field dependent behaviors	FEA for Electric Field
Treeing	Tree Propagation Treeing Shapes	FEA and Cellar Automata Fractal Dimension

MD: Molecular Dynamics DFT: Density functional theory
DFPT: Density functional perturbation theory FEA: Finite Element Analysis

In conclusion, a new wave has ever emerged on computer simulation in dielectrics, which can treat molecular levels. This methods have been long awaited. Ab initio and molecular dynamics simulations are typical representatives. But these methods have limitation in the range of analysis. Improvement is requisite in concept and methods. It is also helpful to combine with conventional macroscopic simulation methods.

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Development of Compact Designed 66/77kV Class XLPE Cable System

There are demands to replace 3-core SCFF cables operated in duct for more than 30 years. From view point of environmental stress free, these cables shall be replaced to XLPE cable in coming decades. However, it's difficult to install the same size of XLPE cable in old duct for SCFF, due to difference in diameters. Therefore, there are needs to develop new products with same (or smaller) diameter as that of SCFF, and their accessories. This paper describes development activities of compact designed XLPE cable (which can be applied to existing duct) and accessories, mainly focused on electrical performance for 66/77kV class.

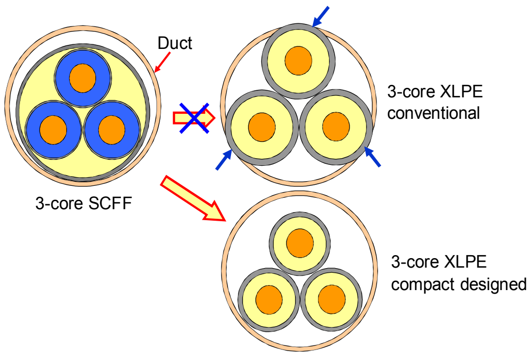

Fig.1 Cable dimensions in duct

The design features of developed product are as follows.

- Cable: Reduce a diameter of 3-core XLPE cable by 10 to 20% mainly by reducing insulation layer thickness.
- Joint: The latest design joint with cold shrink technology which is easy to assemble on site.
- Termination: Two types of terminations. One is contemporary design "Type-I" and another is new developed dry out door termination "Type-II".

Table-1 Features of two types of terminations

Type	Stress controller	Insulating filling	Outer insulator
Type-I	EPDM Stress cone	Silicone oil	Porcelain
Type-II		Gel compound	Hollow composite

Electrical stress tests as shown in table-2 were conducted on compact XLPE cable whose insulation thickness was set to smaller value than target design value, for development purpose. The test result showed good performances.

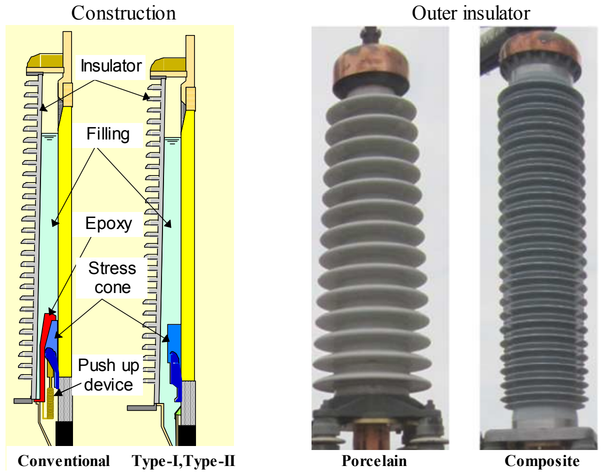

Fig.2 Construction of two type terminations

Table-2 Electrical stress tests (as per JEC-3408)

Item	Test Condition	Results
AC voltage	75kV / 10min(66kV class) 90kV / 10min(77kV class) 130kV / 60min(66kV Type test class)	Good
Partial discharge	75kV / 10min(66kV class) 90kV / 10min(77kV class) 130kV / 60min(66kV Type test class)	Not Detected
Lightning impulse voltage	±485 kV / 3 shots (66kV class) ±550 kV / 3 shots (77kV class)	Good

A loading cycle test on 600mm^2 compact designed XLPE cable system was carried out for 6 months based on JEC-3408 to confirm long-term stability and reliability. Two types of outdoor terminations were arranged in the test circuit. Table-3 shows test results of the loading cycle test and the residual performance tests after load cycle.

Table-3 Result of test loading cycle test

Item	Conditions	Results
Loading cycle test	Loading cycle 180 times RT-90deg C for 150 cycles RT-105deg C for 30 cycles Voltage condition AC 65 kV / 180 days	good
Lightning impulse voltage	±485 kV / 3 shots (66kV class) ±550 kV / 3 shots (77kV class)	good
AC voltage	75kV / 10min (66kV class) 90kV / 10min (77kV class)	good

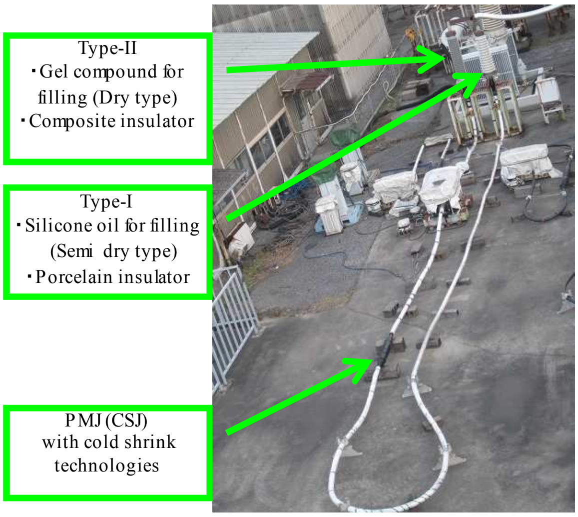

Fig.3 View of loading cycle test

The test results satisfied the requirements of the tests condition described above.

Compact 66/77kV XLPE cable and accessories have been designed. These cable systems can be installed into duct for old SCFF, with the same ampacity of existing SCFF. Excellent electrical properties were confirmed of requirement in Japanese domestic standard (JEC-3408). This system has been already qualified for commercial application and is expected to be used for 66/77kV class application in the near future.

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BOOK REVIEW

Advanced Nanodielectrics - Fundamentals and Applications –

IEEJ Investigation Committee on Advanced Polymer Nanocomposite Dielectrics

Chairperson: Toshikatsu Tanaka, Waseda University

(IEEJ Press, Published in 2014, ISBN 978-4-88686-294-5C 3054, A5-size, 332 pp., JPY 4,100)

“Everything should be made as simple as possible, but not simpler.”, Albert Einstein said. The advanced nanodielectrics, which is composed of the polymer and the inorganic fillers with nanometric dimension (nano-fillers), is extremely simple material. However, this material has a deceptive simplicity. The broad interface between the polymer and nano-fillers dominates properties such as electrical, mechanical and thermal properties. That is not simpler material.

IEEJ Investigation Committee on Advanced Polymer Nanocomposite Dielectrics has conducted the comprehensive investigations on the above-mentioned interesting materials since 2003. As the summarization for the past decade activities, the committee published new book (in Japanese) entitled “Advanced Nanodielectrics - Fundamentals and Applications - ” in September 2014. The chapters of this book are broadly-divided into the “application section”, “basic section” and “principle section” as shown in Figure 2. It extensively covers from the applications of the nanocomposite insulating materials to the principle models of the polymer/nano-filler interfaces.

In particular, the chapter 2 describes the applications in the power and industrial systems, including the epoxy casting resin for solid insulated switchgear, the cross-linked polyethylene for high voltage dc power cable, the enameled wire for inverter-fed motor, the polymeric insulator for outdoor insulation and the interlayer insulation sheet for printed-wiring board. Moreover, the chapter 5 provides the improved electrical properties with nano-filler dispersion such as permittivity, space charge, breakdown strength, electrical tree resistance, partial discharge resistance, tracking resistance and electrochemical migration resistance. The chapter 8 explains the coarse-grained molecular dynamics simulation regarding the polymer/ nano-filler interfaces. The simulation estimates the nano-structure and property attributed to the hydrophobic or hydrophilic interfaces of the fillers.

In closing, the book has four advantages for the understanding of the nanocomposite insulating materials as shown in Figure 3. In the chapter 9, this book describes that the interdisciplinary cooperation between electrical, material, chemical, physical and computer simulation engineering is needed to accelerate the R&D in the industry and academia. This book is the best for readers in every field who are interested in the attractive materials.

Figure 1. Appearance of the book.

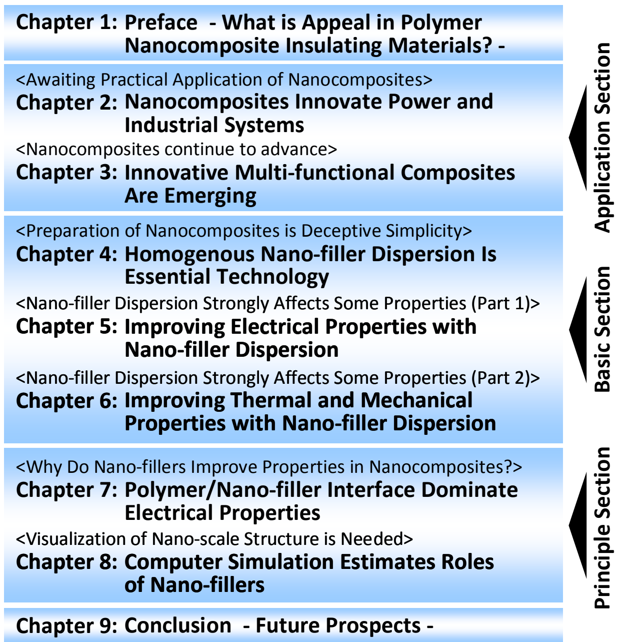

Figure 2. Chapter titles of the book.

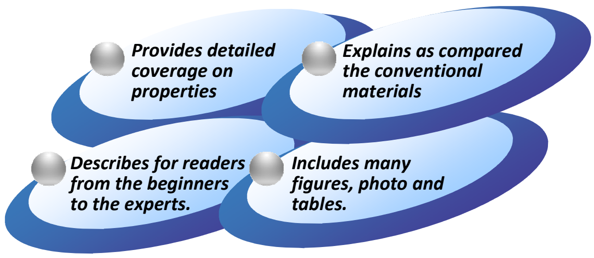

Figure 3. Four advantages of the book for understanding of nanocomposite insulating materials.

Takahiro Imai (Toshiba Corporation, Japan)

MISCELLANEOUS

Photos on Front and Rear Covers

Front Cover

Fukushima Floating Offshore Wind Farm Demonstration Project
(Fukushima FORWARD)
2MW Downwind-type Floating Wind Turbine “Fukushima Mirai”
& 66kV Floating Substation “Fukushima Kizuna”

Fukushima offshore wind consortium is proceeding with Fukushima floating offshore wind farm demonstration project (Fukushima FORWARD) funded by the Ministry of Economy, Trade and Industry. The first phase of the project consists of one 2MW floating wind turbine, the world first 25MVA floating substation and undersea cable have been completed on November 11, 2013.

This project will establish the business-model of the floating wind farm and contribute to future commercial projects. The consortium members are also expected to learn know-how of floating offshore wind farm, which will be one of the major export industries in Japan. The Fukushima FORWARD project believes to help Fukushima to become the center of new industry which will create new employment in this region to recover from the damage of the Great East Japan Earthquake in 2011.

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Rear Cover

Visualization of Electrical Trees by Pulsed Ultrasound Technique

To develop a non-destructive observation system of electrical trees in electric components such as power modules, we used an acoustic microscope with a center frequency of 80 MHz to image electrical trees. The fine structure of trees approximately 0.5 mm in size could be observed. The spatial resolution for trees via our measurement system was about 40 - 50 µm. Furthermore, image processing was employed to acquire a clearer image. Assuming a Gaussian blur function, the original image was deconvolved, improving the spatial resolution by optimizing the standard deviate, which was 20 µm in our experimental condition. To confirm the spatial resolution of trees in an optically non-transparent sample, trees in epoxy resin containing alumina in 3 wt.% as well as an epoxy resin were observed. The half value width of the spatial resolution at tree channels for a non-transparent sample was about 50 µm, which corresponds to that for a transparent sample. Hence, ultrasonic microscope observations are suitable for the non-destructive inspection of electrical trees.

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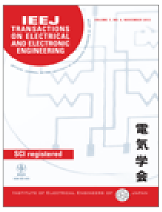
Journals of IEEJ

A Journal which is edited by the headquarters of the Institute and five transactions which are edited by five technical societies* A to E are monthly published.

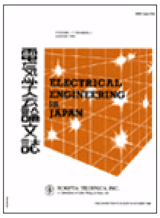


Another transaction “IEEJ Transactions on Electrical and Electronic Engineering (TEEE)” is edited in English by the five technical societies and published bimonthly by John Wiley & Sons.

An English journal “IEEJ Journal of Industry Applications” was launched in July 2012. It is edited by the society D and published bimonthly. .

Papers in all kinds of journals published by IEEJ can be browsed at **Portal site of IEEJ › English Top (http://www.iee.jp/?page_id=1544) › Journal & Paper > Journal (http://www.iee.jp/?page_id=5941)**

Two journals “Electrical Engineering in Japan” and “Electronics and Communications in Japan” are translation of the IEEJ Transactions A, B, C, D and E from Japanese into English both edited and published by John Wiley & Sons (not all articles).



Right: Electronics and Communications in Japan
http://onlinelibrary.wiley.com/journal/10.1002/(ISSN)1942-9541

Left: Electrical Engineering in Japan
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They can be accessed from the website above:
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(*) Five technical societies in IEEJ are as follows:

A: Fundamentals and Materials Society (This magazine is published from EINA Committee under this society.)
B: Power and Energy Society
C: Electronics, Information and Systems Society
D: Industry Applications Society
E: Sensors and Micromachines Society
(please visit Portal site of IEEJ › English Top › Technical Societies)

IEEJ Technical Reports

Technical reports listed below were prepared by investigation committees in technical societies A to E in IEEJ and published from the end of September in 2013 to September in 2014. Their extended summaries can be browsed in English on the web site below but the texts of technical reports are described in Japanese.

No.	Title	Issue date
1292	Recent Technology of Power Converter system for Utility Power Line Interface	2013/9/30
1293	Microstructures, compositions and physical properties of modern superconducting materials	2013/10/10
1294	Data-Oriented Prediction and Control -Data, Data and Data-	2013/10/30
1295	Trend and application of Energy Saving Technology for Steel Industry	2013/10/30
1296	Practical Analysis Techniques of 3-D Electromagnetic Field for Rotating Machines	2013/11/25
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1298	Fusion Power Reactor Based on Spherical Tokamak	2013/12/25
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1301	Present Status and Future Trends of Special Synchronous Machines	2014/2/25
1302	Value creation & Organization cooperation system in the industrial environment of 21st century	2014/3/5
1303	High speed railways systems in the world	2014/3/25
1304	Novel Functions of Nanoscale Magnetic Materials? Fabrication, Evaluation, and Application	2014/3/25
1305	Performance Improvement of Reluctance Torque Assisted Motor by advances in magnetic materials	2014/4/30
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1307	Application technologies of energy storage devices to railway vehicle traction	2014/5/30
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1309	Researches of computing techniques for electromagnetic fields related to human exposure	2014/5/30

1310	ITS and Sensing	2014/6/30
1311	A Development Guideline for Production Scheduling Systems- for successful introduction -	2014/6/30
1312	State of the Art of Worldwide Performance Investigation Technologies for Circuit Breakers	2014/7/15
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1314	Creation of safety and relief environment of electrical installation used in buildings and factories	2014/6/30
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1316	Fluctuation Characteristics and Forecast Methods of Renewable Energy Power Output	2014/8/20
1318	Forefront of the Studies of Organic Dielectrics, Conductive Electrical and Electronic Materials and Cultural Exchange with Asian Countries	2014/9/25
1319	Power Electronics Technologies Applied to Advanced Distribution Networks (Smart Grid)	2014/8/20

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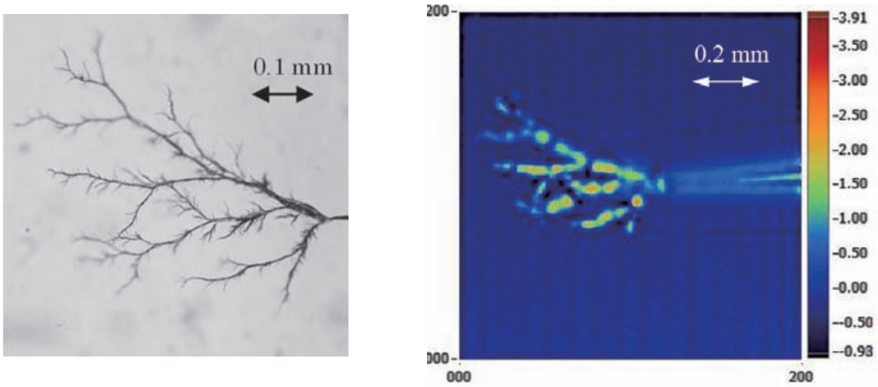
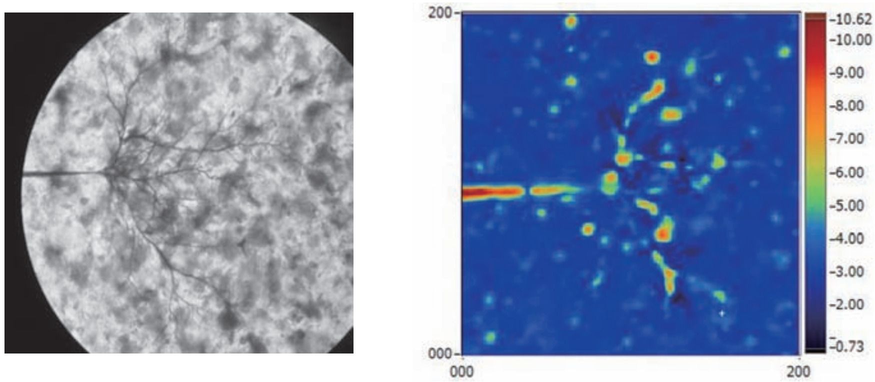
Visualization of treeing breakdown by ultrasound technology



Micrograph and ultrasound image of the tree in the epoxy resin



Micrograph and ultrasound image of treeing of 3wt% alumina filler-filled epoxy resin

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