Electrical Insulation News in Asia

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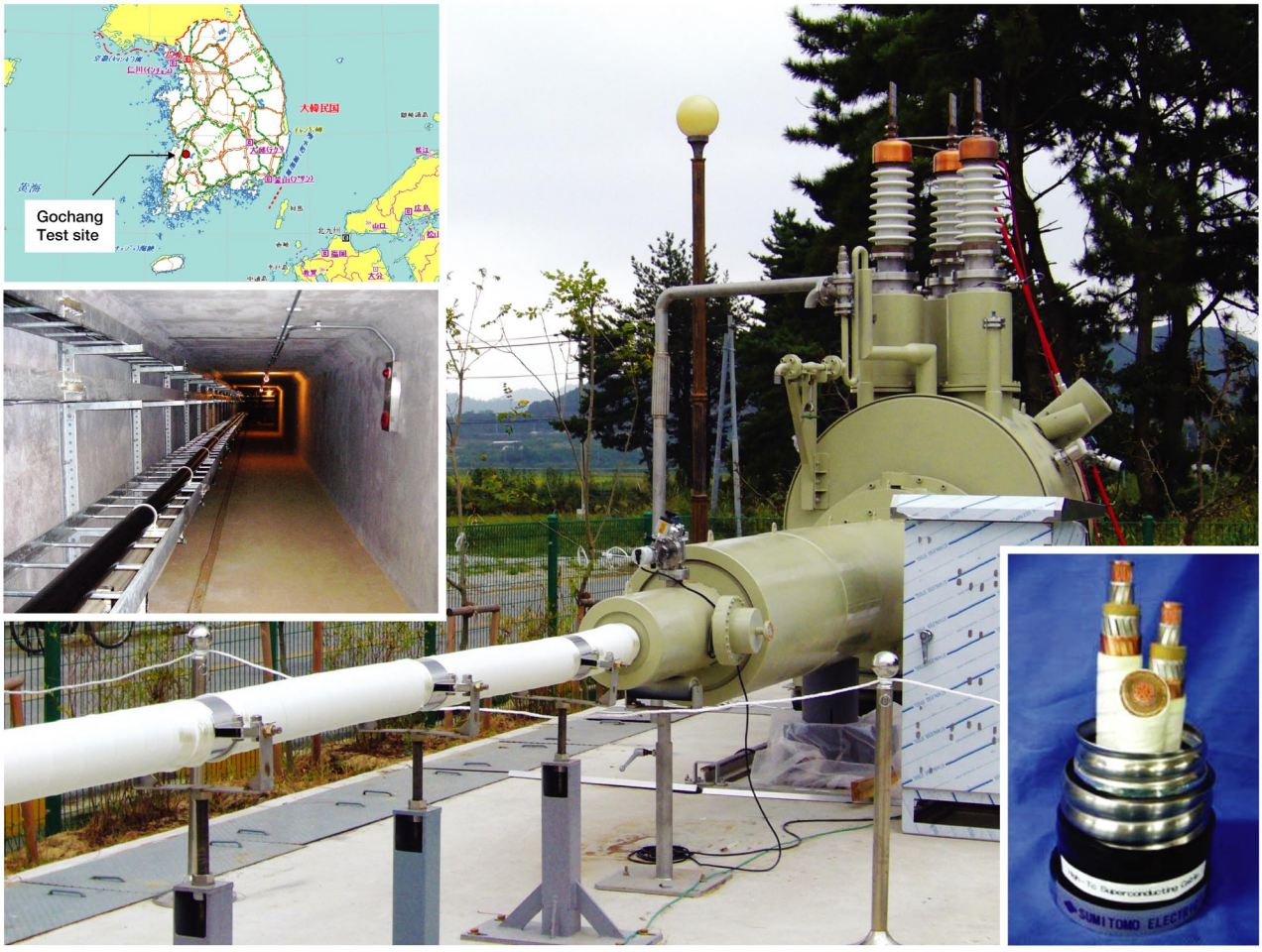

IEEJ

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MISCELLANEOUS

PREFACE

Prof. M. Yumoto

I belong to Musashi Institute of Technology, located on the west side of Tokyo Metropolis faced to the Kanagawa Prefecture. Musashi Institute of Technology was founded as Musashi Senior Engineering School in 1929. Accordingly it has a history more than 75 years and its history is relatively long in Japan.

By the way, a lineup of the Department of Electrical and Electronic Engineering at Musashi I.T. is not so large. However, the colleague engaged actively on a worldwide scale now. The spirited atmosphere in the department have been produced by Professor Yotsuo Toriyama. He arrived at his post on the department of Electrical Engineering that is the former department name of the Electrical and Electronic Engineering in Musashi I.T. in 1957. He put his heart and soul into education of students and/or young staff for the engineer and the researcher during his later half of his life at the Musashi I.T. Before arriving at the Musashi, he worked at Hokkaido University, Tohoku University and Hitachi. He required to his students to understand the intrinsic qualities as the physics of complicated phenomena at each laboratory. His philosophy was received by his students and was inherited to the next generation. As a result, he submitted many subjects as a seed on the field of electrical engineering. For example, to understand the degradation mechanism of insulating materials especially polymer material by partial or creeping discharges, to develop the technology of diagnosis concerning with the degradation of insulating materials and so on are the main research subject at Musashi I.T. These results have lately been put to practical use by the united efforts of a great number of researchers and engineers. For example, the CV cable is already used widely and the project of the UHV transmission system will be realized in P.R.China in the near future.

He had been gone in 1982 and its takes 25 years after his death. During this quarter of a century, so called the money game is becoming to the fore. However, I think that it should be important to encourage the manufacturing industries for the prosperity of most countries. For that purpose, it is very important to cultivate the technical experts and to inherit the technology from generation to generation. On the occasion, the most important point is not only to train technological skill, but also to succeed the philosophy that requires to young engineers to understand the intrinsic qualities as the physics. I would like to keep the philosophy myself and to turn my experience to educate my young students for the good engineers or researchers.

Prof. MotoshigeYumoto

Musashi Institute of Technology, Japan

OUTLINE OF TECHNICAL COMMITTEES IN IEEJ

Dielectrics and Electrical Insulation (DEI)

Chairperson:	N. Hozumi (Aichi Institute of Technology)
Secretaries:	K. Uchida (Chubu Electric Power Co. Ltd)
	Y.Tanaka (Musashi Institute of Technology)
Assistant Secretaries:	M. Okashita (Showa Cable Systems Co. Ltd)
	T. Takahashi (CRIEPI)

The committee was set up in 1979 succeeding the Permanent Committee on Electrical Insulating Materials upon the reorganization of IEEJ. The activities of the committee have been covering mainly solid and composite dielectric materials and relating technologies. The name of the committee changed in 1994 from "TC on Electrical Insulating Materials" to "TC on Dielectrics and Electrical Insulation" aiming to expand the field of activity to electronic and dielectric functional systems.

The important activity of TC-DEI is the annual Symposium of Electrical and Electronic Insulating Materials and Applications in Systems (SEEMAS), formerly called Symposium on Electrical Insulating Materials. In addition, the committee promotes the International Symposium on Electrical Insulating Materials (ISEIM), which is considered as an international version of the SEEMAS. This symposium is normally held every three years. The last ISEIM was held in Kitakyusyu-city with Honorary Chair of Prof. T. Tanaka and General Chair of Dr. T. Okamoto.

The committee is now headed by N. Hozumi of Aichi Institute of Technology, who took over T. Okamoto of CRIEPI. The TC-DEI currently runs nine Investigation Committees (ICs) that organize several technical meetings a year. This year three new ICs have started. T. Tanaka chairs a committee on nano-composite, Y. Tanaka chairs that on irradiated polymeric materials, and H. Homma chairs that on outdoor polymer insulation. The ICs are categorized into four research areas as followings:

Macro-view of DEI technology related

> Environment-friendly materials and systems for electric and electronics application (04/04-03/07, Chairperson: Y.Suzuoki (Nagoya University)

> Economical evaluation of insulation diagnosis (04/04-03/07, Chairperson: N.Hozumi (Aichi Institute of Technology))

New materials including nano-materials related

> Application and improvement of organic molecular films and organic/inorganic composites with controlled nano-structures (04/04-03/07, Chairperson: F.Kaneko (Niigata University))

> Dielectric and insulating materials for information communication (01/04-12/06, Chairperson: K.Fukunaga (National Institute of Information and communication Technology))

> Development of organic electrical and electronic materials with flexible structure to nanotechnology (07/03-06/06, Chairperson: M.Iwamaoto (Tokyo Institute of Technology))

> Interfacial phenomena and application of nano-composite dielectric materials (01/06-09/08, Chairperson: T.Tanaka (Waseda University))

Diagnosis of electric and electronic equipment related

> Being planned.

Basic dielectric and breakdown phenomena related

> Assessment of interaction between polymeric materials and radiation (06/06-05/08, Chairperson: Y. Tanaka (Musashi Institute of Technology))

> Surface function and long-term performance of outdoor polymer insulation materials (01/06-09/07, Chairperson: H. Homma (CRIEPI))

Electrical Discharges (ED)

Chairperson:	T.Nakano	(National Defense Academy)
Vice-chairperson:	M.Hikita	(Kyushu Institute of Technology)
Secretaries:	F.Tochikubo	(Tokyo Metropolitan University)
	A.Kumada	(University of Tokyo)
Assistant Secretaries:	H.Yasui	(Toshiba Corporation)

The Technical Committee on Electrical Discharge (TC-ED) belongs to the Fundamentals and Materials Society (A-Society) of the IEE Japan. The purposes of the TC-ED are mainly in 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.

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. The chairpersons shown in Table 2 currently run four investigation committees. In addition, the investigation committee for the modeling of lightening strokes to structures is planned and will be established this year.

The TC-ED organizes about ten domestic technical meetings on electrical discharges every year. In these meetings, more than 200 full papers are presented in total from both academic and industrial sides by researchers, engineers, professors and students. Some of these meetings take place jointly with the TC on Dielectrics and Electrical Insulation, the TC on High Voltage Engineering and the TC on Switchgear and Protection, the TC on Pulses Power Technology. Besides regular presentations of full papers, poster sessions are placed in these meetings to encourage the young researchers working in the field of electrical discharges. The poster session of this year was successfully held last June in the joint technical meeting of the TC-ED and the TC on Pulses Power Technology.

In order to promote the international activities in electrical discharges, “Japan-Korea Joint Symposium on Electrical Discharge and High Voltage Engineering” has been organized by the TC-EC. The next J-K symposium will be held on the November of 2007 in Tokyo. The special issue of this symposium is also scheduled. The selected papers from all the symposium presentations will be published in the IEEJ Transactions on Fundamentals and Materials in 2008.

The TC-ED also contributes to the organization of a young researcher seminar every year in cooperation with the Institute of Engineers on Electrical Discharges in Japan to encourage the young researchers in the field of electrical discharges. About 40 young researchers and engineers participate in the seminar and discuss vigorously the topics related to electrical discharges for two days.

Table Investigation Committees in TE-ED

Chairperson	Research subjects and established time
H. Yamashita (Keio University)	Extreme technologies for the measurements of electrical discharges in liquids (established in April 2004)
O. Yamamoto (Kyoto University)	Control of electrical discharges in vacuum and high technologies of their measurements and simulations (established in April 2004)
H. Itoh (Chiba Institute of Technology)	Charged species, excited species, dissociated species, photons and the atomic and molecular dynamics (established in January 2006)
T. Oda (University of Tokyo)	Non-equilibrium, atmospheric pressure plasmas and their applications to environment purification (established in January 2006)

Plasma Science and Technology (PST)

Chairperson:	S. Ono	(Musashi Institute of Technology)
Vice Chairperson:	K. Yukimura	(Doshisya University)
Scientific Secretary:	Y. Ono	(University of Tokyo)
	T. Ikehata	(Ibaraki University)
Scientific Secretary Assistance:	K. Teii	(Kyusyu 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 in terms of plasma physical parameters as density, temperature and ionization degree, and application fields as nuclear fusion, plasma processing, and plasma chemistry.

The major activity of this committee is to succeed to organize several Technical meeting on plasma science and technology every year. For example since January 2006, four technical meeting were held; in January at Ibaraki University, in May at Musashi Institute of Technology in Tokyo, in August at Kauai Island Hawaii, in November at Ehime University in Ehime. At each symposium, about 20 to 30 presentations are made. Presentations by young researchers in bachelor course and master course are strongly encouraged and appreciated.

Every two years, TC-PST sponsored international symposium APSPT (Asia pacific symposium on plasma technology) had been held in Taiwan in collaboration with domestic societies related to plasma science and technology since 1999. Recently, APSPT-4 was held in Yunlin Taiwan in December, 2005. Aiming at more flexible management, APSPT-4 became sponsorship by the international organization committee from this time. While many members of TC-PST participate in the international organization committee, TC-PST is continuing playing a role important as a support organization.

TC-PST currently runs two investigation committees, and a few new will be set up in future. The investigating committees dispersed recently, Plasma ion intensive use process investigation committee and Microwave plasma investigation committee, had published their investigation as hard cover books, and it was useful for these books to systematize the newest technology trends of these field.

Table. Investigation Committee in TC-PST

- Spherical tokamak
  (3 years from August 2004, Chairperson: Y. Nagayama (National Institute of Fusion Science))
- The advancement of metal sputtering plasma
  (3 years from January 2006, Chairperson: K. Nakamura (Chubu University))

Pulsed Electromagnetic Energy (PEE)

Chair Person:	Kazuhiko Horioka	(Tokyo Institute of Technology)
Vice Chair Person:	Weihua Jiang	(Nagaoka University of Technology)
Secretary:	Koichi Takagi	(Iwate University)
Assistant Secretary:	Hiroyuki Shinkai	(CRIEPI)

Efforts to enhance the activities in pulse power technology and high energy density physics have been continued in the Technical Committee on Pulsed Electromagnetic Energy (TC-PEE). Researches on pulsed electromagnetic energy have evolved into a well-developed subject in the field of electric power engineering, plasma and discharge engineering, high energy density physics, accelerator engineering and others. By the modification of pulsed electromagnetic energy, we can

make an extremely high energy density (high temperature and/or high density) state that can be utilized for generations of high power lasers, intense radiation sources, high current particle beams, thermo-nuclear fusion and also for formation of new materials. Among others, pulse-power-driven discharge plasmas are expected to be a next generation light source for semiconductor lithography.

As the field of high energy density plasma has a multi-disciplinary nature, extensive discussions of related subjects were difficult in conventional societies. The purpose of this committee is to provide a forum to discuss important technical developments, their applications, increased understandings, new trends, and also future prospects in the field of pulse power technology and the high energy density states. In particular, keeping this field attractive for young scientists and motivating them have been of primary concern for all of committee members.

Regularly, Technical Committee Meetings are held four times a year. To provide international forum and promote international collaborations, the meeting is held once a year, as an international symposium with collaboration among the researchers in Japan, Korea, and China, which is named "International Symposium on Pulsed Power and Plasma Applications (ISPP)". The 6th ISPP-2006 named 1st EAPPC will be held in China (Chengdu, China) on Oct.18-22 (2006) as a joint conference of ISPP and 3rd EPPS (European Pulse Power Symposium). In addition to this conference, the 3rd Japan-US Symposium on Pulse Power and Plasma Applications will be held at Makaiwa, Hawaii, Aug.6-9, (2006). The objective of these conferences is to provide a forum for discussion of the subjects in the field of pulsed electromagnetic energy, mainly in the related countries. However, those research meetings including regular technical meeting, are open for persons whoever interested in the field of pulsed electromagnetic energy.

There is one investigation committee in the TC-PEE; "Industrial Application of Pulse Power Technology", which is chaired by Weihua Jiang (Nagaoka University of Technology). In the committee, highly repetitive pulse-power devices based on recently advanced semiconductor switching and power modulators, in addition to the conventional pulsed power technology. It is predicted that this device should open an innovative application in wider fields; such as materials, energy, environmental, biochemical and/or medical sciences and technologies.

Electromagnetic Compatibility (EMC)

Chairperson:	Z-I. .Kawasaki	(Osaka University)
Secretaries:	Y. Mizuno	(Nagoya Institute of Technology)
	T. Funaki	(Kyoto University)

The Technical Committee on Electromagnetic Compatibility (EMC) behaves to achive their own final goals. Those are

1. Comprehensive understanding of Electrical Power System and EMC issue,
2. Building up 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 this purpose the committee pays their attention on the causes of electromagnetic interference, the situation of electromagnetic interferences, the novel measurement techniques for EMC, the protection technology 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 Lightning Risk and Management for Electrical Power System and Communication System
2. Investigation Committee on Evaluation Technologies for Induced Electric Field and Current in a Human Body Caused by Non-uniform and transitional Electromagnetic Fields.
3. Investigation Committee on Earthquake Predic-

tion by Electromagnetic Filed Measurement.

4. Investigation Committee on High Speed Power Line Communication and EMC

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 "White Paper" named the Report of Investigation Committee.

Electromagnetic environment is the atmosphere in which electromagnetic phenomena exist, and consists of 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. Electromagnetic compatibility (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 Prof. T. Takuma, Prof. O. Fujiwara chaired the committee from 2002, and Prof. Z-I. Kawasaki has succeeded Fujiwara since April, 2005.

The committee organizes technical conferences annually as the Memory of Kobe Earthquake, which occurred on January 17. 1995. The committee holds a few technical conferences, additionally, and those are in March, July, September and November for 2005.

1. Investigation Committee on Lightning Risk Management for Electrical Power System and Communication System

This committee has started its activity in July 2003. Prof. Zen Kawasaki of Osaka University is chairing this committee. The Objectives of the committee activity are followings

1. Risk management for the metal communication network against lightning hazards,
2. Risk management for the optical communication network against lightning hazards,
3. Risk management for the local area (LAN) network against lightning hazards,
4. Risk management for the radio LAN network against lighting hazards
5. Risk management for high power line network against lightning hazards,
6. Risk management for LSI circuit against lightning hazards,
7. Risk management for power electronics facilities against lightning hazards,
8. Risk management for future sensor network against lightning hazards

2. Investigation Committee on Evaluation Technologies for Induced Electric Field and Current in a Human Body Caused by Non-uniform / transient Electromagnetic Fields

This committee was established in July 2006. The mission of the committee is to investigate the methods for calculating the induced electric field and current in a body caused by non-uniform and/or transient electromagnetic fields, and survey articles regarding the related calculation results. This committee also investigates measurement methods, which is indispensable in modeling electromagnetic field source to simulate practical exposure conditions. The committee also performs trend study with focusing on the high resolution electromagnetic field measurement method with compact probes. The following subjects are the items of investigation in this committee:

(1) Investigation of methods for calculating induced electric field and current in an anatomically-based human body model;
(2) Investigation of methods for calculating induced electric field and current in a human body caused by non-uniform and/or transitional electromagnetic field (including the modeling of source and dosimetry);
(3) Investigation of measurement method for wideband electromagnetic field from extremely low frequency to intermediate frequency. Especialy, focused on simplified and rigorous methods;

(4) Investigation of research subjects hereafter;
(5) Preparation of a committee report on the above items.

The committee is just established for taking over from the previous Investigation Committee on Electric Field and Current Induced in a Human Body Exposed to Electromagnetic Fields.

3. Investigation Committee on Earthquake Prediction by Electromagnetic Filed Measurement

This committee has just been established in September 2004. It is chaired by Emeritus Prof. K. Horii of Nagoya University. This committee was located as the succeeding committee for the former "Investigation Committee on Pre-occurrence Phenomena of Earthquakes by the Observation of Environmental Electric Field." According to the previous report, there is large variety of the electromagnetic phenomena related to earthquakes, and a long term universal measurement and research is inevitable to clarify the phenomena. This committee therefore enforced the research activity furthermore and especially focused on the following four subjects:

(1) Analyze various measurement techniques and measurement errors;
(2) Make an inter-comparison and evaluation for measurement results
(3) Analyze the relationship between measured data and earthquakes
(4) Discuss the possibility of establishing a earthquake prediction system

The committee focuses on establishing a highly reliable measurement technology with synthesizing many research results of antecedent electromagnetic phenomena of earthquakes. Periodically research conference is also planned.

4. Investigation Committee on High Speed Power Line Communication and EMC

This committee will be established in December 2004 and chaired by Prof. M. Tokuda of Musashi Institute of Technology. The purpose of the committee is to solve various EMC related problems towards the establishment of power line communication systems. The development of power line communication apparatus are going ahead, while there is a lack of study in depth from a theoretical viewpoint. This committee therefore will promote the researches from an academic viewpoint. It will focus on the following 6 subjects:

(1) The trend of power line communications in domestic and abroad;
(2) The trend of international standardization;
(3) System configuration method.
(4) Origination mechanism of electromagnetic field leakages;
(5) Suppression technology of electromagnetic field leakages;
(6) Current conditions of demonstrative experiments.

Light Application and Visual Science (LAV)

Chairperson: Shinichi Takahashi (Keio University)
Secretaries: Yukitaka Shinoda (Nihon University)
Hisashi Honda (Toshiba Lighting & Technology Corporation)

Activities of the technical committee on light application and visual science (TC-LAV) have been covering fields of optical application for medical treatment, media devices for information processing of visual sense, light sources and their measurement, application of infrared light, and advanced lithography.

Miniaturization of semiconductor integrated circuits has been progressed under the law of Moore in these 40 years, and the minimum feature size has been reduced from several microns to several tens nanometers. Such miraculous progress has not been found in any other technology fields. Half pitches of 65 nm and 45 nm are expected in 2007 and 2010 respectively in International Technology Roadmap for Semiconductors (ITRS). Gate resist pattern widths are narrower, and the targets are 42 nm and 30 nm in 2007 and 2010 respectively. New lithography tools for realizing these small feature sizes are ArF immersion scan exposure systems. Resist films coated on wafers are exposed to ArF excimer laser light with a wavelength of 193 nm in pure water.

Figure 1 shows the values of the numerical aperture of the exposure systems. Systems have been

developed very vigorously, and systems available for device production were announced only for 2-3 years on end. Refraction index of pure water is 1.44 for the 193 nm light, and the resolution is improved corresponding to the index value. Minimum pattern size obtained by projection exposure is often expressed by

$$R=k_1\lambda/NA. \quad (1)$$

Here, R is the minimum pattern width, λ is the wavelength and NA is the numerical aperture of the projection optics. Patterning easiness can be roughly judged by the k_1 value. Calculated k_1 values for 45-nm patterns are shown in the right column of Fig. 1. It is known that k_1=0.3 for NA=1.3.

It should be noticed that the value of k_1=0.3 is not so large to print patterns using only conventional lithography techniques. It is presupposed that phase shifting masks and/or oblique illumination systems selectively effective for one directional or orthogonal patterns are accepted. New methods for dividing patterns into 2 groups alternatively or into vertical and horizontal patterns are also discussed.

Since there are no alternative technologies for production are prepared, immersion lithography is going to be applied for fabricating advanced devices with some ideas in patterning processes.
(Investigation Committee (TC): Advanced Technology for Lithography)

1) K. Nakano and S. Owa: Abstracts, NGL2006, p.8-11, 2006.
2) K. Morisaki: Abstracts, NGL2006, p.12-14, 2006.
3) http://journal.mycom.co.jp/news/2006/07/12/300.html
4) K. Kasama: The Papers of Technical Meeting, LAV-06-1～7, IEE Japan, p.1-6, 2006.
5) http://journal.mycom.co.jp/news/2006/06/13/101.html.

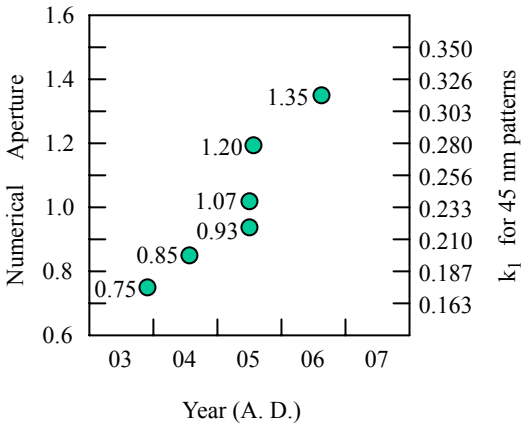


Figure 1 Development of numerical aperture and k1.

In the field of discharge light sources, research on Mercury-free light sources has been most important topics as well as development of high efficacy light sources for these 10 years. In Japan fluorescent lamps has been main target of mercury-free movement because fluorescent lamps are most popular lamps for lighting in Japan. Jinno's group at Ehime University has been carrying on the research on mercury-free xenon fluorescent lamps using an auxiliary external electrode, and reported they achieved 100 lm/W of efficacy and 10000 cd/m^2. This technology is leading the world and is attracting many light source researchers' interests. In the field on PDP Whang's group at Seoul National University reported that they reached 120 lm/W in xenon discharge. Whang's light source's luminous flux is not enough at all, but this result also show the possibility to obtain efficient mercury-free light sources in xenon discharge.

A positive column in xenon discharge is well know to be easily contracted and to form filamentary discharge. Akasi's group recover this phenomena in a 2D numerical model of DBD xenon pulsed discharge.

Another trend of mercury-free light sources is solid state device, that is, LED. In the laboratory chip efficacy of LED has achieved about 80lm/W and as a products in market LED achieved over 25 lm/W. This makes LED possible to be a substitute of incandescent lamps. Recently light sources manufacturer and researchers are strongly interested in LED, especially in Europe and USA. Though LED is the one of the hot topics in the field of light sources, light sources researchers also think that at the moment because of their low efficacy, small luminous flux it is difficult for LED to replace fluorescent lamps. LED manufacturer announced within a few years LED's efficacy will reach over 150 lm/W. At that time LED could be a substitute for mercury fluorescent lamp.

The COST21 program in Europe has been making a effort to establish a standard for metal halide for benchmark. Now the test lamps are available and are delivered to research group in the world. Now many reports about measurements, modeling and observation of this standard lamp are expected.(TC: Diagnostics and Modeling of New Light Sources)

The third topics is non-invasive monitoring of blood glucose by optical method. According to the diabetes survey in 2002 of our country, it is presumed that the total number of persons having diabetes and the possibility of diabetes are 16,200,000 in Japan.

The commonly used potable blood glucose

sensor utilizes the character of the enzyme electrodes. The resistivity of the enzyme electrodes changes in proportion as glucose concentration, when the glucose in blood reacts the oxygen of enzyme electrodes. The method is unsuitable to a child, a newborn infant and a diabetic who needs measurement of blood glucose level several times in a day.

The device using interstitial fluid of the skin without collection of blood has been released in U.S.A. But there are some problems on the application of human body; (a) it cannot response to rapid change of glucose level and (b) it causes inflammation as it attaches firmly to the skin.

Therefore, the optical blood glucose sensor has been expected because it is non-invasive and is capable to yield the continuous data of blood glucose level.

A method which estimate the blood glucose level from the absorption of glucose is the simplest. From the reflection spectrum of skin of the oral cavity or the transmitted light of a finger, the blood glucose level was monitored.

However, light absorption of glucose corresponding to the criterion level of diabetes is extremely weak even at the absorption band of glucose of 1.6 μm. The temperature fluctuation of water absorption masks the change of transmitted light intensity owing to the change of blood glucose level.

In biological tissue, the difference of refractive indices between the floating small particles and the medium, which causes the light scattering, is very small. The scattering coefficient is thought to be very sensitive to the change of refractive index of the medium which is a function of the glucose concentration. Therefore, the change of glucose concentration is estimated from the change of the scattering coefficient.

The change of the scattering coefficient by glucose have been detected as the change of intensity of quasi-ballistic component in transmitted light or the change of OCT (optical coherence tomography) signal. The high rate of change of signal intensity owing to the glucose level is expected in comparison with methods measuring absorption. However, there is a problem that the refractive index by blood glucose cannot be distinguished from that by other ingredients because the spectrum parameter peculiar to glucose is not employed.

In addition, trials such as measurements of optical rotation by glucose, Raman scattering spectrum by glucose, PAS signal of glucose have been performed to estimate the blood glucose level. However, the practical optical glucose sensor for medical diagnosis has not been developed till now.
(TC: Infrared Application for Safety and Peace)

History of Electrical Engineering (HEE)

Chairperson:	Yasuharu Suematsu	(National Institute of Informatics)
Vice-Chairperson:	Satoru Yanabu	(Tokyo Denki University)
Secretaries:	Masami Sukeda	(Hitachi, Ltd.)
	Masao Takahashi	(Toshiba Corporation)
Assistant secretaries:	Akio Toda	(Mitsubishi Electric Corporation)
	Toshiaki Maruoka	(Toshiba Corporation)

The Technical Committee on History of Electrical Engineering (HEE) belongs to the Fundamentals and Materials Society (A-Society) of the IEE of Japan

The main objective of HEE is to examine the direction in which electrical engineering should move in the years ahead by studying the past. Electrical engineering history constitutes the basis of technologies that we should develop. It is the starting point from which we should approach the future.

Now, 3 investigation committees are organized in the HEE and are running actively for survey of the subjects listed in Table 1. The investigation committee for history of technology interaction is an international joint study group. The members are consisting with Japanese, Europeans, Americans and Asians. Field study in overseas is planning in this committee.

The international workshop that called The Maui meeting is promoted by HEE. The last Maui meeting was held at University College London on 30 June and 1 July 2004 and the next Maui meeting is planning to be held in Americas. HEE have organized a panel discussion on research into electrical engineering history at the ICEE. Each

conference holds a panel discussion emphasizing the importance of electrical engineering history.

Meetings for presenting research papers on electrical engineering history are held regularly under the auspices of the HEE. Starting in 1991, meetings have been held three times a year, so a total of 42 meetings have been held already and more than 300 research papers have been presented.

Public information activities are running by HEE. One of these activities is the publication of a newsletter. Inaugurated in 1994, the newsletter reached its 40th issue this year. The four-page publication features technological history-related articles, records of visits to museums and book reviews. Another important public information activity is the web site. This web site was opened in 2001 and it announces workshops, publishes the summaries of research papers presented at the meetings, and publicize the committee's activities as I have mentioned in connection with the activities. The newsletters and the web site are in Japanese only but the web site in English will be soon. Please visit
http://www.iee.or.jp/fms/tech_a/ahee/index_e.html
.

Table 1 Investigation Committees in HEE

Research Subject	Chair Person
・Factors of Innovation in the Postwar Development of Electrical Engineering	Takayuki NAGATA (National Science Museum)
・History of Technology Interaction (JULY 2005 -)	Fumio ARAKAWA (Global Engineering Institutes)
・Award-presenting system study in the Electrical Engineering (June 2006 -)	Masami Watanabe (Mitsubishi Electric)

High Voltage Engineering (HV)

Chairperson:	S.Yokoyama	(CRIEPI)
Secretaries:	I.Aono	(Mitsubishi Electric Corp.)
	K.Hoshina	(Toshiba Corporation)
Assistant Secretary:	Y.Mizutani	(CRIEPI)

This technical committee (TC) belongs to Power & Energy (P&E) Society of the IEE of Japan, and supervises activity of investigation on technical subjects related to high voltage engineering. Five investigation committees listed in Table 1 are active in August 2006.

The 4th International Workshop on High Voltage Engineering (IEHV 2004) was held in Sapporo city, following the 1st IWHV at Okinawa in 1999 , 2nd IWHV at Tottori in 2000 and 3rd IWHV at Fukuoka in 2003.

The objective of this workshop is to provide a forum to discuss novel findings in field of high voltage engineering, mainly in Asian countries. The workshop will be organized every alternate fiscal year. Selected papers of the IWHV with original and interesting findings will appear in a special issue of the Transactions of IEE of Japan.

There were 8 sessions, where 40-60 papers were presented orally for two days. All speakers presented their paper in English, following fruitful discussions.

The workshop banquet was held also where many participants changed various information of the world wide technology of electric power industries, and the research on electric discharge phenomena while enjoying the food (and history) .Next IWHV will be held in Hamamatsu cityof Shizuokaken on 1st and 2nd of February of 2007.

We hope the next IWHV 2007 will also be valuable workshop for exchanging the information related to rapidly moving technology of high voltage engineering.

In November 2005 a joint technical meeting of IEEJ with TCs on Electrical Discharge and Switchgear and Protection was held in Takamatsu of Shikoku District.

TC on High Voltage Engineering meeting meets four times a year. One of the meetings will be as-

sociated with a technical visit to Kobe area.

The members of the committee other than the chairpersons of the investigation committees are from universities (4), a research institute (2), electric power utilities (4) and manufacturers (9).

Table Investigation Committees in TC-HV

Research Subject	Chairperson
Manner of Lighting Damages to Wind Power Stations	S.Yokoyama (CRIEPI)
Insulator Coordination (Performance measurement technology)	T.Matsumoto (Shizuoka University)
Mechanism of Lightning Outages on Distribution Lines.	Y.Moro-oka (Kyushu Electric Power Company)
Surge Phenomena on Low-voltage and Control Circuits	T.Funabashi (Meidensha Corp.)
Numerical Electromagnetic Analysis Methods for Surge Problems	A.Ametani (Doushisha University)

Electrical Wire and Cables (EWC)

Chairperson:	Takahisa Imajo	(Electric Power Engineering System Co., Ltd)
Secretaries:	Kazushi Nakaya	(Exsym Corporation)
Assistant Secretary:	Shigekazu Yokoyama	(Viscas Corporation)

Technical Committee on Electrical Wire and Cables (TC-EWC) is a committee organized to support the IEEJ Power and Energy Society, and includes members from universities, power and communication utilities, the JR railway company, Japan Electric Cable Technology Center, JECTEC and cable manufacturers. The technical committee holds technical meetings to promote R&D activities in this field and provides an opportunity to present the results of technical achievements. Tree technical meetings was held as the joint meeting with TC-DEI, on January 28, 2005, in Nagoya, and focused on the subject of “Deterioration Diagnosis and economical Assessment”. In addition to organizing such technical meetings, the technical committee supervises investigation committee dealing with subjects, which are related to electrical wire and cables.

During the several years of activity, Investigation Committee for DC Cable Systems, the Investigation Committee for Technology of Wires and Associated Accessories for Overhead Transmission Lines, and the Investigation Committee for Computer Software and Its Application for Power Cable Line were organized. This year, two investigation committees are in action. The name and chairpersons of the committees are listed in Table 1.

Occasionally a technical visit by the committee members is made to encourage study on the advanced science and technology. This year, the committee members visited the Central Load Dispatching Center by Tohoku Electric Power Co, Inc.

Table 1 Investigation Committee in TC-EWC

Research Subject	Chairperson
Investigation Committee for Accessories for 66kV and Higher Voltage XLPE Power Cable	A. Toya
Technical Trend and Problem for Underground cable Distribution System	J.Motohashi

Instrumentation and Measurement (IM)

Chairperson:	Katsunori Shida	(Saga University)
Vice- Chairperson:	Yoshitaka Sakumoto	(Japan Electric Meters Inspection Corporation)
Secretaries:	Terumitsu Shirai	(Japan Electric Meters Inspection Corporation)

The field of instrumentation and measurement technology is very wide and has a long history.
The activity of our committee is always influenced by the technological trend in the era.
The early activities of this committee have mainly focused upon the presentation and discussion of studies and researches in the fields of electrical standards and precise measurement in various electrical fields. It is the reason that our committee is now categorized in the society A (Fundamentals and Materials) of IEEJ. Technological contents in our committee have, however, gradually shifted to various electrical and electronic fields.
Annual activities in the technical committee of instrumentation and measurement have roughly introduced as follows.

i) The general meeting of the committee is held four times every year for discussing the various activities of the committee. 15 members including a chairman, a secretary and an assistant-secretary constitute the committee.
ii) The meeting by the chairman, the secretary and the assistant-secretary is held four times every year for tentatively planning the activities of the committee.
iii) The workshops for the presentation and discussion of studies and researches are taken place almost every month in principle as a main activity.
iv) The professional research committee for special subject is under consideration.
v) The visit of professional facility is planning to carry out twice per year.

The actual subject matters in the workshop are the presentation and the discussion of extensive electronic instrumentation and measurement technologies including;

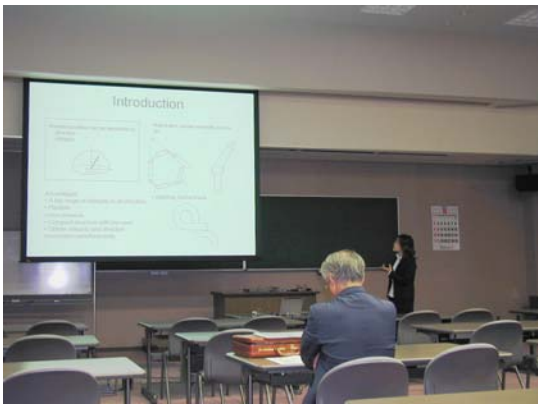
Ultra-high speed electronic instrumentation
Electro-magnetic measurement related with electrical environment
Optical measurement applied to electronic instrumentation
High precision electronic instrumentation applied to frequencies and time domain
Bio-electronic measurement applicable to the welfare field in society shifted to the aged
Magnetic measurement related to magnetic sensors.

The workshops mainly take place at Tokyo area, and sometimes in Saga (Kyushu Island), in Osaka and in others. The theme of presentation in the workshop is usually focused on the electromagnetic measurement, the remote control instrumentation, the application of optical measurement, the biological electronic measurement, the time and frequency measurement, the application of magnetic measurement and so on, but in several workshops, miscellaneous subjects are acceptable to present and discuss there.

The number of annual presentation in the workshops is around 80 titles. The workshop is supported by IEEE IM and sometimes by other organization.

A professional research committee for special subject by the name of the application technology of precise measurement for frequency and time has successfully concluded. (the chairman: Prof. Sakuta)

Our committee website (http://www.im-ieej.com/) also assists to understand our activity.



One scene of some workshop

Written by Prof. Katsunori Shida, Chairman (Saga University)
e-mail: shida@cc.saga-u.ac.jp

Metal and Ceramics (MC)

Chairperson: Yasuzo Tanaka (International Superconductivity Technology Center)
Secretary: Masanao Mimura (Furukawa Electric Co., Ltd.).

Welcome to our Technical Committee on Metal and Ceramics (TC-MC) in the Institute of Electrical Engineers of Japan (IEEJ). It is expected the TC-MC to promote the electrical materials and related technologies. Therefore, we have the pleasure to inform activities of the TC-MC and to communicate with each other.

Mission of TC-MC

The metal and ceramic materials are indispensable to electric and electronic fields and in front of advanced technologies all the time. In the twenty-first century, many advanced technologies need promising materials such as new materials or new functional materials for the diversification and renewable society. Therefore, the metal and ceramic materials are significant still more and will play an important role as a pioneer in the future.

As shown in figure 1, the activities of the TC-MC have been covering mainly electric, electronic and optical materials, and their technologies. Namely their functions are extended such as superconductivity, normal conductivity, semi-conductivity, mechanical strength, heat transfer, thermoelectric, photo-electricity, optical transmission, electrochemical affinity, radio- activity, composites etc.

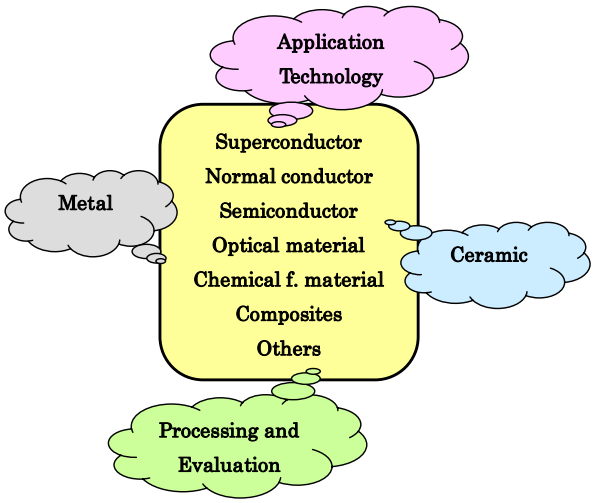


Figure 1 Activity scope of the TC-MC

Furthermore, our activities have been covering data base on their processing technologies and their evaluations in order to fit any applications.

History of TC-MC

The technical committee on the electrical materials in the IEEJ, predecessor of the present the TC-MC has been already set up in 1979. With several reorganizations of the technical committees, the TC-MC under the Fundamental and Materials Society (called A-Society) has been established in 1999 with other eleven technical committees, Research and Education, Electromagnetic Theory, Plasma Science and Technology, Electromagnetic Compatibility, Pulsed Electromagnetic Energy, Electrical Discharges, Light Application and Visual Science, Insulation and Measurement, Dielectrics and Electrical Insulation, Magnetics, and History of Electrical Engineering.

Recent activities of TC-MC

The activity of the TC-MC is based on the Symposium in the National Convention of the IEEJ, the Investigation Committee and the Study Meeting under the TC-MC. The following introduces the resent Symposiums in the National Convention of the IEEJ as shown in Table 1, and the second activities will be found in the next section.

Regularly, the TC-MC meetings are held four times a year. The main topics to be discussed in the regular meetings involve introduction and understand for advanced metal and ceramics, and development of our TC-MC itself. Last three years, we provided new four technologies and related materials such the current nano-technology, the attractive carbon nano-tube and the functional diamond.

Last year, much attention has been paid on an investigation on advanced materials for future batteries and fuel cells to be compatible with clean, green and renewable society.

Table 1 Symposiums in the National Convention of the IEEJ

Theme	Date	Site
Observation on nanotechnologies and super- conductors	2003.03.17	Tohoku-Gakuin University
Attractive carbon nano-tube as a new electric and electronic material	2004.03.17	Aoyama-Gakuin University
Remarkably advanced diamond for electric and electronic materials	2005.03.17	Tokushima University
Electrode materials for fuel cells and the secondary butteries	2006.03.17	Yokohama National University

Activities of Investigation Committee in TC-MC

As of 2006, there is one investigation committee under TC-MC as shown in Table 2, the name of which is “Fabrication technologies and characterizations of advanced superconducting materials”. The chairperson and secretary are Dr. Hiroaki Kumakura (National Institute for Materials Science, NIMS) and Dr. Takao Takeuchi (NIMS), respectively. Regularly, there are six meetings a year.

The meetings discuss fabrication technologies and evaluations on electromagnetic, thermal and mechanical properties mainly for Nb3Al conductors, Bi-based oxide superconductors, MgB2 conductors and Y-based oxide superconductors. Most expecting investigation results are fabrication technologies to produce a long-length wire for MgB2 and Y-based oxide, and their cost performance as the practical superconductors and their applied technologies to such as persistent current mode-coil, cable, transformer, fault current limiter and so on. As an intermediate result, 3¥/Am-coated conductors of the Y-based oxide superconductor will be available in the near future.

Table 2 Investigation Committees under the TC-MC

Research Subject	Chairperson (Affiliation)	Period	Remarks
Superconducting materials and electronic devices	Nobuyuki Yoshikawa (Yokohama National University)	1999.10-2002.09	Close
Wire and conductor forming of superconducting materials	Shirabe Akita (CRIEPI)	2001.10-2004.09	Close
Fabrication technologies and characterization of advanced superconducting materials	Hiroaki Kumakura (NIMS)	2004.10-2007.09	Active

IEC Japanese National Committees Related to Electrical Insulating Materials

IEC TC15 Japanese National Committees

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

Japanese National Committee for TC15 had four meetings in the last year. TC15 is a very busy committee; during the last year, 32 drafts for standardization concerning to TC15 have been received from IEC Central Office, including CD, CDV and FDIS, all of which were deliberated and discussed in the meetings of the national committee. Furthermore, 24 voting results or compiled comments, and 7 maintenance cycle reports were circulated in the member of the national committee.

For the activities on the working groups in the TC, the experts from Japan participate in WG5 (flexible insulating sleeving), WG7 ((reactive resinous compound and varnish). This year, a new exert joined to WG9 (cellulosic materials).

TC15 plenary meeting has been annually held. This year, the meeting was held during the 3rd week in May in Vienna Austria. More than 40 persons were attended in the meeting.

In July last year, IEC SC15C was transformed into IEC new TC15 by a decision of IEC SMB, because a new TC112 was constructed merging TC98 into SC15E in April last year. The corresponding Japanese National committees were reconstructed according to the IEC new structure. The title of new TC15 is "Solid Insulating Material", which was accepted in the Vienna meeting. The tasks of the new TC15 are almost unchanged from that of SC15C, which are focused on, but not limited, to, the development and maintenance of international standards on specifications for solid electrical insulating materials alone or in simple combinations. This includes coatings which are applied in the liquid state but cure to solids, such as varnishes and coatings.

IEC TC112 Japanese National Committee

Chairperson:	N. Shimizu	(Meijo University)
Vice Chairperson:	T. Okamoto	(CRIEPI)
Secretaries :	K. Haga	(Fuji Electric System Co., Ltd.)
	K. Kimura	(Mitsubishi Electric Corporation)
	N. Nakamura	(Japan Electrical Safety & Environment Technology Laboratories)
	H. Uehara	(Kanto Gakuin University)

Title of TC112 is "Evaluation and Qualification of Electrical Insulating Materials and Systems". TC 112 was established in 2005 May by a merger of SC 15 E "Insulating Materials - Methods of Test" and "TC 98 Electrical Insulation Systems". The chair of TC112 is Dr. P.V. Ronca (Canada), the former Chair of TC 98. The Secretary is Mr. B. Göttert (Germany), the former secretary of SC 15 E.

The Scope is **"**To prepare International Standards covering methods of evaluation and qualification for electrical and electronic insulating materials and electrical insulation systems". The participant members and the observer members are 20 countries and 6 countries respectively. Japan is one of the participant members.

The TC112 Japanese National Committee was established in October 2005. The members of TC112 JNC are came from both the former SC15E JNC and TC98 JNC; 40 experts from universities, research institutes and industries serve as the member. The officers are as follows:
Chair: Prof. N. Shimizu (Meijo University)
Vice Chair: Dr. T.Okamoto (Central Research Institute of Electric Power Industry)
Secretaries : Mr. K.Haga (Fuji Electric System Co.,Ltd.)
Dr. K.Kimura (Mitsubishi Electric Corporation)
Mr. N. Nakamura (Japan Electrical Safety & Environment Technology Laboratories)
Prof. H. Uehara (Kanto Gakuin University)

TC112 has 8 working groups WG1-8. It should be mentioned that the two convenors for WG.7 and WG.8 are from our Japanese National Committee. Corresponding to these WGs in the international field, JNC has also 8 WGs in the domestic field. WGs are shown below with name of covenor in international field and chief in Japan.
- WG 1 Thermal Endurance (Convenor Prof. Montanari, Italy / Chief in Japan Dr. Kaneko)
- WG 2 Radiation (Mr. Dawson, UK / Prof. Kudo, Tokyo University)
- WG 3 Electrical Strength (Prof. Stimper, Germany / Dr.Kimura, Mitsubishi Electric)
- WG 4 Dielectric / Resistive Properties (Mr. Haupt, Germany / Prof. Watanabe)
- WG 5 Tracking (Dr. Winter, Germany / Dr. Honma, CRIEPI)
- WG 6 Systems (Dr. Densley, Canada / Mr. Sakano)
- WG 7 Statistics (Dr. Okamoto, Japan / Dr. Okamoto, CRIEPI)
- WG 8 Various Material Properties (Prof. Shimizu, Japan / Prof. Shimizu, Meijo University).

CIGRE SC D1 Japanese National Committee
(Materials and Emerging Technologies)

Chairperson:	M. Nagao	(Toyohashi University of Technology)
Secretary:	M. Tsuchie	(Mitsubishi Electric Corporation)
Assistant Secretary:	T. Takahashi	(CRIEPI)

CIGRE (International Council on Large Electric Systems) is a permanent non-governmental and non profit-making International Association founded in 1921. In 2002 Study Committees (SC) were reconstructed to 16 committees belonging to 4 categories: A (Equipment), B (Subsystems), C (Systems) and D (Horizontal). Among them, SC D1 was characterized as a horizontal one which contributes to other SC's in categories A, B and C. The title of SC D1 is "Materials and Emerging Technologies" and the mission is to facilitate and promote the progress of engineering and the international exchange of information and knowledge in the field of materials and emerging technologies for power systems.

SC D1 has now 12 Advisory Groups (AG) and Working Groups (WG); SAG (Strategic AG)・CAG (Customer AG), WG D1.01 (Fluid-Impregnated Insulating Systems), WG D1.03 (Insulating Gases), AG D1.05 (Capacitors), WG D1.07 (Solid Insulating Materials for Rotating Machines), WG D1.12 (Materials for DC Applications), WG D1.14 (Material properties for nonceramic outdoor insulation), WG D1.15 (HTSC-material applications & cooling), WG D1.16 (High Field Phenomena in Solid Insulation and Interface). WG D1.17 (HV Asset condition assessment tools, data quality and expert systems), WG D1.18 (Impact of emerging generation technology) and WG D1.33 (HV test and measuring techniques). In 2006 Paris meeting, 2 new WG's will start, namely, WG D1.19 (Solid insulation endurance under transient voltages) and WG D1.20 (Non-destructive water treeing detection in MV XLPE cables).

The preferential subject of 2006 SC D1 Paris Group meeting reflects recent topics of SC D1 as follows, PS1 (11 papers): Partial Discharge measurement with non-conventional systems (sensors, sensitivity, calibration; related knowledge rules; comparison with conventional systems), PS2 (6 papers): Materials issues in emerging technologies (reusing of materials, refurbishment, life extension), PS3 (6 papers): High performance materials and new materials for severe operating conditions (nano materials, superconducting materials, space charge-less materials, bio dielectric materials, eco-friendly materials, etc.). 23 papers are presented on these PS and following 5 papers are presented by Japanese as first author; D1-106 New Development for Detecting Partial Discharge Using an UHF Method and Its Application to Power Apparatus in Japan by M. Hanai, et al., D1-206 Cross-Equipment Evaluation of Material Techniques Based on Electrical Insulation Performance in Electric Power Equipment by H. Okubo, et al., D1-303 Superiority in Partial Discharge Resistance of Several Polymer Nanocomposites by T. Tanaka, et al., D1-305 Various Dielectric Characteristics of Polymer Nanocomposites by T. Tanaka on behalf of TF D1.16.03 and D1-306 Development and Application Trend of Superconducting Materials and Electrical Insulation Techniques for HTS Power Equipment by H. Okubo, et al. on behalf of WG D1.15.

The next 2007 International SC D1 meeting is scheduled in Korea and the Japanese National SC D1 has usually 3 or 4 meetings a year.

STRIKING MESSAGE FROM VI PROFESSORS

In Retrospect

Masamitsu Kosaki

Emeritus of Toyohashi University of Technology and Gifu National College of Technology

I started working on polymer insulating materials under the instruction of Prof. Ieda at Nagoya University(NU) in 1961. During that period I spent three years at University of California, Berkeley and received Master's Degree. After coming back from US, I joined the Prof. Ieda's research group(RG) and studied electrical conduction and dielectric phenomena of polymeric insulating materials such as polyvinylchloride, polyvinylfluoride and polyethylene. I received doctoral degree from NU in 1971. I left Prof. Ieda's RG for Prof. Horii's RG in NU. Then I initiated the work of electrical insulation phenomena and design in the cryogenic temperature region aiming at the application for superconducting power apparatuses. We found an intriguing phenomenon in a polyethylene treeing sample in liquid nitrogen. Namely, the tree starting voltage is extremely high and the needle tip emits electroluminescence. I convinced that this can be applied to the electrical insulation design in the cryogenic region. Bearing this idea in mind, I went to Brookhaven National Laboratory(BNL) in US where the prototype 100m superconducting cable was under way. I learned valuable know-how in the cryogenic engineering at BNL, although my unique concept of designing a solid polymer electrical insulation was not seriously discussed in the BNL superconducting cable development.

Soon after I came back from US, I moved to Toyohashi University of Technology(TUT) in 1979 which was brand new university and accept 80 percent of students from graduates of college of technology(CT) in the third year. They are generally cap able and hard working and, therefore I had extremely good time with them. Fortunately the new university provided us an ample size of laboratory space to carry out superconducting cable experiments. I worked hard on the extruded polymer insulated low temperature superconducting cable which is cooled by liquid helium. The first and second versions of the electrical insulation design employing low density polyethylene and extruded polyethylene cracked during the cooling process down to liquid nitrogen temperature and liquid helium temperature respec-

Development of extruded polymer insulated low temperature superconducting cable in Toyohashi University of Technology

tively. The third version took advantage of ethylene propylene rubber(EPR) which had showed excellent performance as a cryogenic bushing. This was so successful that it could be cooled down to liquid helium without cracking of insulation. We tried both current and voltage test of the cable with success. I sincerely hope that EPR insulation could be applied to the high temperature superconducting power cable and apparatuses in future.

After nineteen years in TUT, I was asked to take the position of the presidency of Gifu National College of Technology. I was very pleased because I worked with many graduates from college of technology(CT) in TUT. The CT is said to be the most prosperous school system ever introduced by Ministry of Education, Science and Culture since the end of the last war. Sixty-two CTs are evenly distributed throughout the country. Students spend five academic years in CT after junior high school. It is possible to introduce specialized curriculums from early years, which is very effective and fruitful. I found out the reason why graduates of CT were highly talented and studied hard in TUT. After graduation of CT they go directly to industries, junior year of university including TUT or the advanced course of CT. Faculty members of CT are well qualified. We can count as many as twelve researchers of electrical insulation and dielectric phenomena in whole CT. They are active members of IEEJ.

I have valuable memory of International Conference on Properties and Application of Dielectric Materials(ICPADM) which has been held in Asian and Oceanian countries in every three years. ICPADM started in 1985 in Xi'an, China and the last one, the 7th ICPADM was held in 2003 in Nagoya, Japan. I took part in every ICPADM and enjoyed the visit of various countries and also the productive exchange of ideas on research topics. Through these seven ICPADM, I strongly impressed by the growing enthusiasm of Asian colleagues in the electrical insulation and dielectric phenomena. It is evident that the ICPADM attracts world wide attention and plays a role of information emission source of Asian researchers. I sincerely hope the sound and vital progress of ICPADM in years to come.

I retired from Gifu National College of Technology in the end of March 2006.

Bridge between Science and Technology in the Electrical Insulation Field

Teruyoshi Mizutani

Emeritus Professor of Nagoya University

I joined late Prof. Ieda's laboratory at Nagoya University in 1969 when I received Ph. D from Dept. of Electronics, Nagoya University. My doctoral thesis was concerning with semiconductor Si. As you know, the rapid progress in semiconductor electronics has been made under a good collaboration of solid-state physics and semiconductor technology. A junction transistor, for example, was predicted theoretically by a research team of Bell Laboratories in 1948 and it was realized experimentally a year later. This was a starting point of microelectronics.

Electrical insulation has been one of my main interests since 1969. My first impression of electrical insulation was that there were so many things unknown in insulating materials unlike semiconductors. Take the charge transport in polyethylene (PE) with the simplest chemical structure (which has been widely used and extensively studied) for example, we can not answer clearly the following fundamental questions;

1. Which are dominant carriers, electrons, holes or ions?
2. Which is the transport process, band conduction or hopping? The band structure of PE ?
3. The origins and energy distributions of carrier traps? etc.

Therefore, I decided to start my research aimed at the understanding of the physics behind electrical insulation phenomena such as conduction, breakdown and aging. The environment and the period (1969-2005) of my research on electrical insulation at Nagoya University are shown in Fig. 1. During this period, fortunately, the research on electrical insulation became more and more active with a rapid increase in the demand of electricity in Japan and high- voltage and/or large –capacity power apparatuses and cables were developed and put in sevvice. The first UHV (1000kV) power transmission line was completed in 1992(TEPCO) [Unfortunately, it is not yet in service because of a recent economic recession, although the technology of the UHV power transmission is already accomplished.] The first long- distance CV cable lines at 275 and 500 kV in Japan were also put in service in 1989 and 2000 (TEPCO).

In '70s and '80s, lots of works were done on the development of high-performance power apparatuses

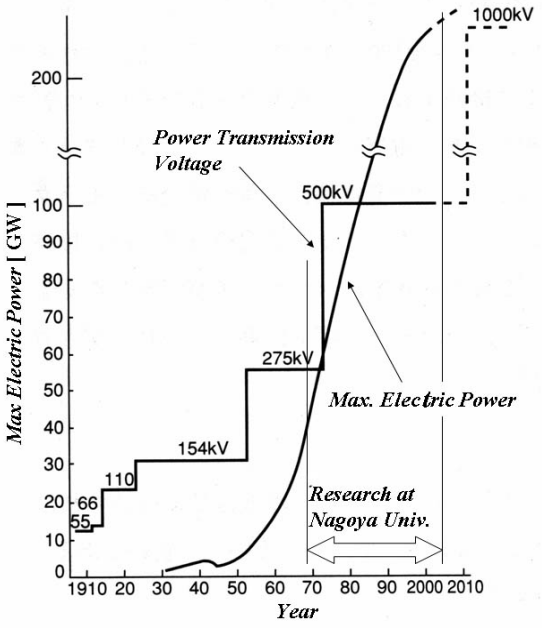


Fig. 1: Period of my research on electrical insulation at Nagoya Univ.

and cables and the improvement of insulation sys--tems and the electrical insulation technology much progressed mainly through the improvements of manufacturing process and quality control. However, the physics behind fundamental phenomena (conduction and breakdown) almost remained unclear in spite of lots of research works. Conduction and breakdown of organic materials are very sensitive to various factors such as physical/chemical structures of materials, additives, impurities, interfaces, atmospheric conditions and so on. More systematic studies on well-characterized specimens are required in order to clarify the physics.

Modern measuring techniques, computer simulations and process techniques to prepare well-characterized specimens will enable us to clarify the physics behind such complicated phenomena. One can directly observe the movement of charge carriers with the PEA or LIPP method, for example. Now is a good time to do such fundamental research works. The bridge between science and technology or the understanding of the physics behind electrical insulation technology is strongly required for the further development of insulation systems.

Recently, much attention has been paid to organic devices such as organic LED and transistor which are one of my recent research subjects. Many papers have been published on the charge transport in organic materials used in organic devices. Their results are very useful to understand the conduction and breakdown phenomena in organic insulating materials, because both organic materials have a lot in common.

*__Prof. Mizutani__ retired from Nagoya University in 2005. He is now Emeritus Prof. of Nagoya Univ., Visiting Prof. of Aichi Inst. Tech. & Shinshu Univ. and also President of JECTEC (Japan Electric Cable Technology Center, Inc.).
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Initiation of ICPADM and Internet Age

Tatsuo Takada

Emeritus Professor of Musashi Institute of Technology

The first ICPADM in China and the start of collaborative research with Xian Jiaotong University

Professor Ziyu Liu and I have worked together as a visiting scientist at High Voltage Laboratory, MIT, from 1981 to 1982. We made a round trip from Boston to New York, Pennsylvania, and Connecticut to visit several universities and institutes. During the trip, he talked with some of the leading scholars about how China needed to overcome the academic loss caused by the China's Culture Revolution.

So he has initiated the International Conference on Properties and its Application of Dielectric Materials (ICPADM) , which was held in Xian,China,1985.

At the conference, I saw the eagerness of Chinese graduate students to know about the academic situation of other countries. Prof. Liu Ziyu and I started collaborative research between the labs. Each year, Prof. Liu Ziyu and Prof. Tu Demin had sent some excellent students and visiting scientists to my lab. During the last decade, we have published many papers of developing process of the pulsed electro-acoustic method and the electro-optical method for observing electric charge behavior in dielectctric materials.

The age of Internet based on submarine cable system

When we started the collaborative research with Xian Jiaotong University twenty years ago, our main communication tool was the "letter by air mail" taking weeks to get reply.

Nowadays, thanks to the internet, your message will instantly send by e-mail, and you can easily share information on the website regardless of the distance. The picture shows the optical submarine cable system of the eastern and south-eastern Asia. You might notice how it is concentrated in the region.

The operation of cable laying started in 1990 taking about 10 years to complete. The mutual dependence of industrial economy and educational and cultural activity of the region is based on the system, as well as geostationary satellite system.

Utilization of the Internet for international collaborative research

Thanks to the information technology such as the submarine cable system, collaborative researches among foreign institutes are becoming more and more intense. Using internet, we can communicate by e-mail, discuss on Bulletin Board Service (BBS), have online lecture for expertise, and so on. And when those research activities to be put on the EINA (Electrical Insulation News in Asia) Website, it will contribute more lively interaction among laboratories.

RESEARCH ACTIVITIES AND TECHNICAL EXCHANGES IN ASIAN COUNTRIES

Conference Records

International Conference on Condition Monitoring and Diagnosis (CMD2006)

The first International Conference on Condition Monitoring and Diagnosis (CMD2006) organized by The Korean Institute of Electrical and Electronic Material Engineers (KIEEME) and Korean Electrotechnology Research Institute (KERI) was held at Changwon Exhibition and Convention Center in Changwon city, Korea, from 2nd to 5th of April, 2006. CMD2006 was held for presentations and discussions among engineers and researchers with the view of sharing their knowledge, experience and ideas in this emerging multidisciplinary science area.

Short Report on CMD2006

The first CMD Conference, originated from ACEID (Asian Conference on Electrical Insulation Diagnosis) among China, Japan and Korea and dealing with one of the fast growing fields in the world, was on the table with approximately 360 technical papers contributed by delegates from 33 countries with over 300 registered participants as shown in Table 1.

These days, we are in needs of not only faster and faster flow of monitoring and diagnosis, but also in need of safer and more environment-friendly methods. To meet these requirements, technology must be developed much greater than ever before. We strongly believe that those trends were accomplished by the most extraordinary papers from all over the world as well as 8 plenary lecturers and 5 tutorials the organizing committee invited to take this opportunity to boost CMD industries as shown in Table 2~3.

CMD2006 had very various scopes and important sessions such as Strategic Planning and Management for Condition Monitoring, CMD Technologies under Ubiquitous Environment, and CMD for HV Power Apparatus and Systems.

Also, most prominent professionals like Prof. Keith Nelson, Mr. Pierre Boss, and Prof. Toshikatsu Tanaka, Prof. Guan Zhicheng gave all participants the informative and distinguished lectures as the highlights of the whole occasions.

During the conference, we had an International Board Meeting with the representatives of CMD2006 International Steering and Advisory Committee to decide the next hosting country, hosting cycle and period for CMD and discuss other agenda for future of the forthcoming CMD conferences. The representatives of each Society had signed the MOU as shown in Figure 4 at the meeting. After a successful

Table 1 Invited Lecture Program of Plenary Session

Speaker	Affiliation	Title
Prof. Keith Nelson	Rensselaer Polytechnic Institute (USA)	A comparative assessment of PD and EMI methods from the EPRI generator field condition monitoring program
Prof. Zhicheng Guan	Tsinghua University (China)	Ongoing hydropower and long distance transmission projects in China
Mr. Boss Pierre	ABB Secheron Ltd CIGRE (Switzerland)	Overview on the activities of CIGRE Study Committee A2 "Transformers" and related links with IEC standardization bodies
Prof. Toshikatsu Tanaka	Waseda University (Japan)	Decision Making in Asset Management of Power Apparatus and Systems
Mr. J. Auke Wiersma	ENECO Energie (Netherlands)	Trends and Developments in Substation Technology
Mr. Liu Chang-dong	Three gorges Hydropower Plant (China)	Research on the Management Strategy of Main equip-ments in the Three Gorges Left Bank Power House
Prof. Suk-han Lee	Sungkyunkwan Univ.(Korea)	Condition Monitoring in Service Robotics
Dr. Alexander Apostolov	AREVA T&D Automation (USA)	IEC 61850 and Its Impact on Condition Monitoring and Diagnosis

Table 2. Program of Tutorials

Speaker	Affiliation	Title
Mr. J. Auke Wiersma	ENECO Energie (Netherlands)	Modern Substation Technology
Mr. Boss Pierre	ABB Secheron Ltd CIGRE (Switzerland)	Economics of Trans-former Management
Prof. Keith Nelson	Rensselaer Polytechnic Institute (USA)	Basic Theory and Interpretation of PD and EMI On-line Monitoring in

		Large Machines
Mr. Reinhard G. Schroth	CIGRE (Germany)	Technical and Environ-mental Issues Regarding the Integration of New HV Cable Systems in the Network
Mr. Deepak Parmar	Geotherm Inc. (Canada)	Importance of External Thermal Environment on the Rating of Under-ground and Submarine Transmission Cables

conversation and discussion we decided eventually that the next upcoming CMD will be held in Beijing China 2008.

As General Chairman of CMD2006, I really hope that conference was a beneficial experience for all participants and it is expected that they had a memorable time with many new and old friends in beautiful city, Changwon. Further, I would like to give my most heartfelt thanks to all delegates from all over the world and the member societies for the efforts they have given to assist in this scientifically successful Conference.

We believe that CMD2006 would be remained as a good opportunity to announce the critical role in the progress of vanguard fields such as Technology, Electronics and Telecommunication especially under "Ubiquitous Environment"

The topics of CMD2006 are as follows

- Special Topics

A. Condition Monitoring and Diagnosis Tech-nologies under Ubiquitous Environment
B. Monitoring and Diagnosis System for Nuclear Power Plant
C. Condition Monitoring and Diagnosis for System Environmental Performance
D. Digital Substation
E. Intelligent Power Distribution System
F. Life Line Corrosion Control and Monit-oring
H. Monitoring and Diagnosis System for GIS

- Main Topics

1. Condition Monitoring for Power and Gas /Oil Plants
2. Diagnosis and Condition Monitoring for HV Power Apparatus and Systems
3. Investigation into the Mechanism of Electrical, Mechanical, Thermal, Chemi-cal and Electronic Failure Phenomena
4. Applications of Information Technology in Asset Management
5. Strategic Planning and Management for Condition Monitoring
6. Monitoring in the Electricity Markets and Regulation under Various Economic Aspects

Table 3 Invited lectures in each Technical Sessions

Speaker	Affiliation
Prof. Guan-Jun Zhang	Xi'an Jiaotong University (China)
Dr. Toshihiro Takahashi	CRIEPI (Japan)
Prof. Ernst Gockenbach	Univ. of Hannover (Germany)
DR.Ir. Suwarno	Bandung Institute (Indonesia)
Prof. Edward Gulski	Delft University (Netherlands)
Prof. Michael Muhr	Graz University (Austria)
Dr. Katsumi Uchida	Chubu Electric Power Co. (Japan)
Prof. Yoshimichi Ohki	Waseda University (Japan)
Dr. Brian Stewart	Glasgow Caledonian University (United Kingdom)
Dr. Greg Stone	Iris Power Engineering (Canada)
Prof. Satoshi Matsumoto	Kyushu Institute (Japan)
Prof. Johan J. Smit	Delft University (Netherlands)
Mr. W. M. McDermid	Manitoba Hydro (Canada)
Prof. Guangning Wu	Southwest Jiaotong University (China)

Figure 1 All Participants

Table 4. Numbers of Submitted Papers from each country

Country	Number	Country	Number
Australia	4	Kuwait	2
Austria	7	Libya	1
Brazil	7	Malaysia	2
Canada	8	Netherlands	13
China	77	Romania	2
Croatia	1	Russia	9
Czech Rep.	4	Singapore	1
Finland	2	South Africa	5
France	2	Spain	1
Germany	14	Sweden	4
India	12	Switzerland	2
Indonesia	6	Thailand	15
Iran	4	United Kingdom	6
Israel	1	USA	9
Italy	4	Venezuela	1
Japan	24	Yugoslavia	1
Korea	110		
Total		**368**	

Figure 2 Plenary Session

Figure 3 Poster Session

Figure 4 Memorial Photo snaps of Inter-national Board Meeting after MOU Signing Meeting
(From left to right,
Mr. Jean Kowal (CIGRE General Secretary, France),
Dr. George Chen (IEE UK),
Mr. Bill McDermid (IEEE DEIS, USA),
Prof. Kyu-Bock Cho (KIEEME, Korea),
Dr. Tatsuki Okamoto (IEEJ/KRIEPI, Japan),
Prof. Guan Zhicheng (CES / Tsinghua Univ. China))

Figure 5. Welcome Reception
(From left to right,
Prof. Dae Hee Park (Wonkwang Univ.),
Prof. Kee Joe Lim (Chungbuk Univ.),
Prof. Toshikatsu Tanaka (Waseda Univ.),
Prof. Yoshimichi Ohki (Waseda Univ.))

Prof. Kyu-Bock Cho, Ph.D.
General Chairman of CMD2006
kbcho@hanseo.ac.kr / bionicsys@hotmail.com

International Conference on Properties and Applications of Dielectric Materials (ICPADM 2006)

Dates: June 26 to 30, 2006
Venue: Bali, Indonesia
Sponsor: IEEE DEIS
Chairperson:
Dr. Ir. Suwarno, Bandung Institute of technology
URL: http://www.melsa.net.id/~icpadm06/

Purpose and outline:

The ICPADM has been held every three years in the Pan-Pacific region since 1985 and this is the 8th time. The purpose of this conference is to provide an international forum for discussion and exchange of the latest advances in science and technology of dielectric materials. The Liu Ziyu and Ieda Memorial Lecture was given by Prof. G. C. Montanari and invited lectures was given by Prof. T. Tanaka and Prof. S. Gubanski.

Number of attendees:

205 persons (Indonesia 78, Japan 33, China 30, Korea 21, Germany 7, Malaysia 7, Others 29)

Number of papers:

235 papers from 22 countries
28 Sessions including 2 Plenary Sessions,
18 Oral, 4 Short-Oral and 4 Poster Sessions

Session theme and number of related papers:

Partial discharge 13, Space charge 11, Nano composite 12, New measurement 13, Tr & Rotating machine 12, GIS & Cable 16, Others 30 (except poster papers)

Keynote speeches/Awards:

(1) Liu Ziyu and Ieda Memorial Lecture:
Insulation diagnosis of HV apparatus by PD investigation (Italy)

(2) Promising characteristics of nanocomposite dielectrics (Japan)

(3) Performance and diagnostics of biologically contaminated insulators (Sweden)

Personal Impression:

The ICPADM 2006 was very successful as the results of much effort of the host country. There were 205 attendees from Asia, Oceania, North America and Europe. And 235 papers were presented. "Nano composite" and "Diagnosis and Asset management" looked to gather much interest of the attendees. Especially, 20 papers were presented at the session of "Nano composite". There were so many tourists at the Bali Island at the time in spite of the bombing last year. All attendees could have wonderful time at the most famous tourist resort in the world.

Dr. Swaruno, Chairperson of ICAPDM 2006.

Mr. H. Orton at Welcome reception.

Welcome reception. Left to right: Dr. G-Y. Kim, Prof. Sekii, Prof. Mizutani, Dr. J-W. Hong, Dr. Swaruno.

Prof. T. Tanaka at Invited lecture.

Prof. Gubanski at Technical session.

Lunch time.

Group photo of all attendees of ICPADM 2006.

Reported by
Prof. Y. Sekii (Chiba Institute of Technology)
<sekii.yasuo@it-chiba.ac.jp>

International Conference on Electrical Engineering (ICEE 2006)

Dates: July 9 to 13, 2006
Venue: YongPyong, Korea
Organizer: KIEE
Co-organizer: IEEJ, CSEE, HKIE
Chairperson:
Prof. Heung-Jae Lee, Kwangwoon Univ.
URL: http://icee2006.kiee.or.kr

Purpose and outline:
A conference theme is represented by "Innovation and Convergence". ICEE2006 was trying to provide a forum to address these issues with the theme of innovation and convergence in electrical engineering and technology. In addition to 24 technical sessions of 336 technical papers, a keynote speech session, panel sessions and a special session were specially organized.

Number of attendees:
549 persons (Korea 365, Japan 151, China 22, Hong Kong 6, Others 7)

Number of papers:
536 papers (Korea 375, Japan 140, China 28, Hong Kong 9, USA 3, Spain 1, Iran 1, Germany 1, Taiwan 1, Oman 1, Indonesia 1, Sweden 1, and Russia 1)
Oral 206, Poster 191, Panel session 31

Session theme and number of related papers:
Electrical machines 52, Materials 43, MEMS 39, High voltage technologies 25, Applied superconductivity 13, Control and automation 39, Diagnosis and sensors 29

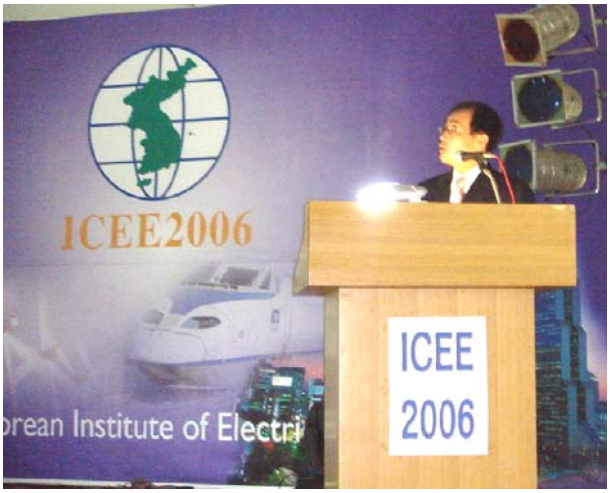
Keynote speeches:
(1) Global Perspective of Engineering Education and Research (Korea)
(2) Electricity Supports Energy Society in the Future (Japan)
(3) China's Approach to Future Power and Energy Need: Considering Renewable Energy as a Priority in Energy Development (China)
(4) Sustainability of Electricity and its Lighting Applications (Hong Kong)

Panel debate theme:
R&D Strategies and Programs for Convergence and Innovation in Electrical Engineering and Technology

Special Session:
Education in Electrical Engineering in Preparation for Emerging Technologies

Personal Impression:
The conference was well received and well balanced in several individual themes. It was also matched with its main theme of innovation and convergence. It is worthwhile to note titles of the keynote speeches, and themes for panel debate and special session.

Next Conference:
Hong-Kong, July 8-12, 2007.
http://www.icee-hk.org



Prof. Min-Koo Han, President Elect of KIEE (Seoul National Univ.) made a keynote address on "Global Perspective of Emerging Education and Research".

Prof. Min-Koo Han (left), President Elect of KIEE of Korea and Prof. T. Tanaka, Chairman of EINA magazine Committee of Japan.

Panel Debate on R&D Strategies in Electrical Engineering. From left to right: Mr. D-K. Kim (KERI), Prof. S-I Moon (Seoul National University), Dr. H. Konishi (Hitachi), Prof. K. Nara (Ibaraki University), Dr. F-C. Chan (University of Hong Kong), Prof. C-C. Chan (University of Hong Kong), Mr. X. Bai (China EPRI), Dr. J-W. Choe (LS Industries).

Panel Debate on R&D Strategies in Electrical Engineering. Dr. K-Y. Lee (Penn. State University) Chairperson (Standing).

Reported by **Prof. T. Tanaka**,
Waseda Univ.
<t-tanaka@waseda.jp>

Announcement of International Conference to be held in Asia

ICEE 2007 (International Conf. on Electrical Engineering)

Dates: **July 8-12, 2007**
Venue: **Hotel Nikko Hongkong, Hong-Kong**
Organizer: The Hong Kong Institution of Engineers (HKIE)
Co-organizers: The Chinese Society for Electrical Engineering (CSEE)
The Institute of Electrical Engineers of Japan (IEEJ)
The Korean Institute of Electrical Engineers (KIEE)
Theme of the conference:
Intelligent, Clean, Efficient Electricity for the 21st Century with focus on sustainability and reliability
Key dates: **Abstract Submission: 31 December 2006**
Full Papers Submission: 1 April 2007
Conference Secretariat:
Susanna Pang / Tiffany Hsiao (HKIE)
9/F Island Beverley, 1 Great George Street
Causeway Bay, Hong Kong
Tel : (852) 2895 4446, Fax : (852) 2203 4133
Email : conf3@hkie.org.hk
URL of the website: http://www.icee-hk.org

2007 Japan-Korea Joint Symposium on Electrical Discharge and High Voltage Engineering

Dates: **November 2007**
Venue: **Tokyo, Japan**
Organizer: Technical committee on Electrical Discharge of IEEJ
Co-Organizer: Technical committee on Electrical Discharge and High Voltage of KIEE
Contact person: Prof. Toshiki Nakano
National Defense Academy of Japan
E-mail: tn@nda.ac.jp

CMD 2008 (International Conf. on Condition Monitoring and Diagnosis)

Dates: **April 21-24, 2008 (*)**
Venue: **Beijing, China**
Organizer: North China Electric Power University, China
Chair Person: Prof. Chengrong Li (North China Electric Power University)
Website: http://www.cmd2008.com/ (under construction)

(*) The date of the conference is in the process of application to the foreign affair office of Beijing. The official announcement will be appeared on the website above.

ISE'13 (2008 IEEE International Symposium on Electrets)

Dates: **September 15-17, 2008**
Venue: **Tokyo, Japan.**
Contact person: Prof. Takeo Furukawa
Department of Chemistry, Science University of Tokyo
1-3 Kagurazaka, Shinjuku, Tokyo, Japan
Phone: +81 3 5228 8250, Fax: +81 3 3235 2214,
Email: tfurukaw@rs.kagu.tus.ac.jp

State Key Laboratory of Electrical Insulation and Power Equipment Xi'an Jiatong University

Kai Wu
Xi'an Jiatong University, China

The **S**tate **K**ey **L**aboratory of **E**lectrical **I**nsulation and **P**ower **E**quipment (**SKLEIPE**) at Xi'an Jiatong University was initially approved by the National Planning Commission in 1989 as a developing avenue of the key academic disciplines funded by the World Bank (WB) loans. It was formally established in 1991 and opened to the public sector during October 1995. At present the laboratory is managed by the Director, Professor Jianhua Wang, and the Director of the Academic Committee, Professor Qingquan Lei who is a member of the Chinese Academy of Engineering.

The laboratory is supported by two state key academic disciplines namely "**High Voltage and Electrical Insulation Technique**" and "**Electrical Machine and Electrical Apparatus.**" These two disciplines include two additional sub-disciplines comprising of "*Power Electronics and Electrical Drive*" and "*Electrical Theory and New Techniques.*" The **SKLEIPE** is located in a new building of 5,600 square meters. It possesses advanced instruments and power sources for studies on dielectric properties, discharge characteristic, insulating materials, insulation structures, chemical and physical analysis, large-scale simulation and signal measurement and analysis etc., totally with a present market value of about $3,600,000. This facility is nationally competitive and capable of providing precise and systematic research tools to the prospective investigators. Now 32 professors, more than 10 guest researchers and a large number of Doctoral and Master's candidates are working in SKLEIPE. The main research fields include:

dielectric property and breakdown strength of insulating system, on-line diagnosis and condition-based management, arc theory and gas insulation techniques, functional materials and new insulation techniques, and development in the theory and techniques of power equipment etc.

Fig. 1 The building for SKLEIPE.

Since the installation of the laboratory it has conducted outstanding research programs and acquired remarkable achievements via receiving research support from the State and Local Governments. These activities are focusing on global competitiveness and effectiveness in the frontier of electrical insulation and power equipment in addition to the academic and general research areas concerning with key scientific problems in civil, economic, and national defense.

Fig. 2 The high-voltage hall on the ground floor.

Since 1997 this laboratory has won 2 National Awards and 10 Local Government Awards in conducting scientific research including 3 National Awards in teaching and generating textbook. It has published over 900 papers and 11 monographs and textbooks. Also it has hosted and conducted 4 International Conferences.

Approximately $100 million worth of production value support have been provided to the manufacturing sectors for commercial applications via scientific and engineering technology transfer from this laboratory.

Fig. 3 The 3rd floor for the experimental instruments of physics/chemistry analysis.

Maintaining the policy of "Openness, Flexibility, Alliance, and Competitiveness", this laboratory has become a world-known source and base for remarkable contributions in the scientific research, teaching, academic communion, and technology transfer to the commercial arena for applications in the general field of electric power development in China.

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Activities of High Voltage Research Laboratory at Indian Institute of Technology - Madras

Ramanujam Sarathi
Department of Electrical Engineering, Indian Institute of Technology Madras
Chennai- 600 036, India; E-mail: rsarathi@iitm.ac.in

The High Voltage Laboratory at IIT Madras was established during 1969-70, under the expert advice of Prof. Dieter Kind, University of Braunschweig, Germany with the assistance provided by Federal Republic of Germany. Since then, it has grown to the current state of art research lab to cater to needs of carrying out cutting edge research work, evaluation/testing, and educational activities.

The following facilities are available in the high voltage laboratory.

(i) High Voltage Testing Transformer

The 800 kV, 400 kVA, 50 Hz cascade transformer has two stages, each rated for 400 kV. The measuring system consists of an 800 kV, 100 pF, SF_6 filled standard capacitor and peak/rms reading instrument.

(a) **(b)**

(a) Power Frequency Test Transformer
(b) Lightning Impulse Voltage Generator

(ii) Lightning Impulse Voltage Generator

The 1.5MV, 37.5 kJ lightning impulse voltage generator, manufactured by Messwandler-Bau (MWB) of Germany, has six stages, with a 0.2 µF,250 kV generating capacitor in each stage. A 1.5 MV capacitance divider and a 2 MV fast response compensated RC divider are available for impulse voltage measurement.

(iii) High Voltage Schering Bridge

The Schering Bridge, manufactured by M/S Schering-Rutloh constructions, Germany rated 200 kV, 50 Hz consists of a 100 pF nitrogen filled standard capacitors and screened bridge arms. The measurement ranges are: loss tangent 10^{-5} to 10 and Capacitance -0.1 to 1 µF.

(iv) Partial Discharge Detector

The WSTS make wide band partial discharge detector facilitates measurement in the range of 5 -1000 pC with a maximum voltage level of 100 kV.

(a) **(b)**

(a) Partial Discharge Detector
(b) Baukasten Unit

(v) Pulse Power Unit

Recently, BARC has donated a 780 kV, 80 J high voltage nano second pulse power unit to the high voltage laboratory. This facility is used for research work in the area of food preservation.

A number of high voltage experimental setup kits consisting of components of standard dimensions are available for setting up of laboratory experiments for under-graduate and graduate students and for conducting research work up to 200 kV AC, 250 kV DC and 250 kV impulse voltage.

High voltage laboratory, IIT madras supports nearby power equipments manufacturers in design and testing of their manufactured components.In addition, the sponsored projects were obtained from the government funding agencies.

1. Ministry of Human Resources and Development
2. Department of Science and Technology

3. Department of Bio-technology
4. Department of Armament Research Board

Current research projects of the High Voltage Laboratory faculty include

(a) Study of Tracking Phenomena in Insulating Materials

Tracking is basically a carbonaceous process, which occurs at the surface of the outdoor insulating material during operation. Researchers worldwide are trying to understand the mechanism of tracking and to mitigate this problem in polymeric insulators. Owing to the practical significance of this problem, the collaborative research work has been initiated in our laboratory with the support of *Prof. Noboru Yoshimura, Akita University, Japan*.

Tracking Experimental Setup with a tracking photograph

An important contribution based on the collaborative work is made to classify the surface condition of insulating material during operation using leakage current measurement followed by adopting predictive capability of wavelets and neural networks. Certain physico-chemical diagnostics studies were carried out to understand the characteristic features of polymeric insulators. At present, the research scholars in HV Lab. are working on the project entitled "Tracking phenomena in nanocomposites insulating materials".

(b) Study of Electrical and Water Treeing in XLPE Cables

"Partial Discharges", a pre-breakdown phenomenon accounts for pre-mature failure of underground cables. These pre-breakdown channels formed around the defect site in the dielectric structure resemble branches of a tree and, hence, the name "treeing" is given to the deleterious process and since such an occurrence is purely due to electrical stress, the mechanism is termed as "Electrical Treeing". Another aspect is that the diffusion of water into the cable insulation form treed structure called water trees. Fundamental studies were carried out to understand the dynamics of electrical trees under different voltage profiles and characteristic changes that occur in cables insulation near the treed zone studied through analytical studies.

(a) (b) (c)

(a) Electrical Tree (b) Water Tree
(c) Fractal Model of Electrical Tree

Generating electrical trees is basically a cumbersome process and visualizing the tree pattern requires sophisticated equipments. Hence modelling studies were carried out to understand the growth patterns of electrical trees homo and heterocharges present in the insulation material. Also studies were carried out to obtain relation between the growth rate and shape of the tree pattern generated through fractal studies. The work is under progress to understand the growth rate of electrical trees incepted from the water-treed zone. Modeling of tree structures in nanocomposites is one of the ongoing research activities in the laboratory.

(c) Study of breakdown characteristics of Insulating material at cryo-temperatures

In India, the study of breakdown characteristics of insulating materials at cryo temperatures is at infancy stage. High voltage laboratory at IIT Madras has taken initiative to work in this emerging area. To start with, treeing phenomena under different voltages using AE technique is being studied. Collaborative research work with *Prof. Hitoshi Okubo, Nagoya University, Japan* has been initiated.

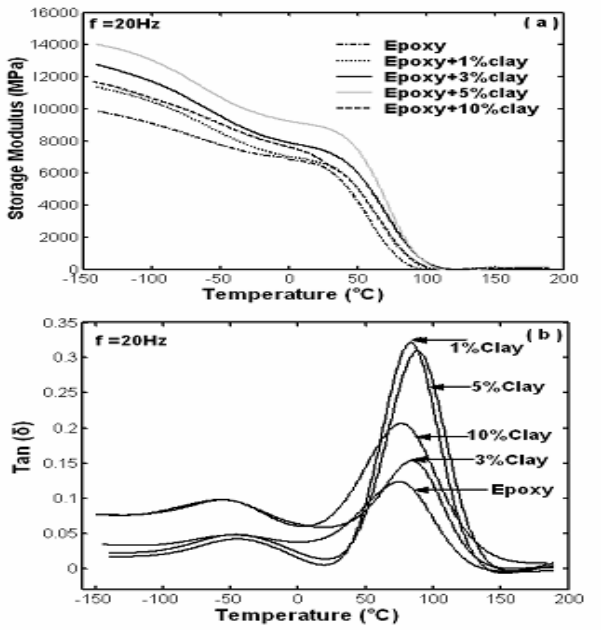
(d) Condition monitoring of GIS using AE technique and UHF Method

Condition Monitoring of Gas insulated systems using AE technique is one of the major areas of research in this laboratory. We have shown that it is possible to mitigate the particle dynamics in GIS by applying composite voltages formed by negative DC and the supply voltage using AE technique. Also, symmetrical dot patterning technique is adopted to classify the incipient discharges from discharges at near point of failure. Identification and classification of partial discharges by adopting UHF sensor technique are being investigated in HV lab.

(e) Nanocomposite material for outdoor insulation

High performance polymer nanocomposites are emerging as a new class of materials for its de-

manding applications as insulating material. Nanocomposites are named when the dispersed phase particle size is less than 100 nm. Reinforcement of polymeric resin with nanoclay platelets as fillers has resulted in light weight materials with increased modules and strength, decreased permeability, less shrinkage, increased heat resistance, decreased flammability and good electrical insulation characteristics. It is planned to understand the characteristic life of nanocomposites material aged under different voltages and to understand the pollution performance of nanocomposites. This work is in progress with the support of *Prof. T. Tanaka, Waseda University, Japan.*



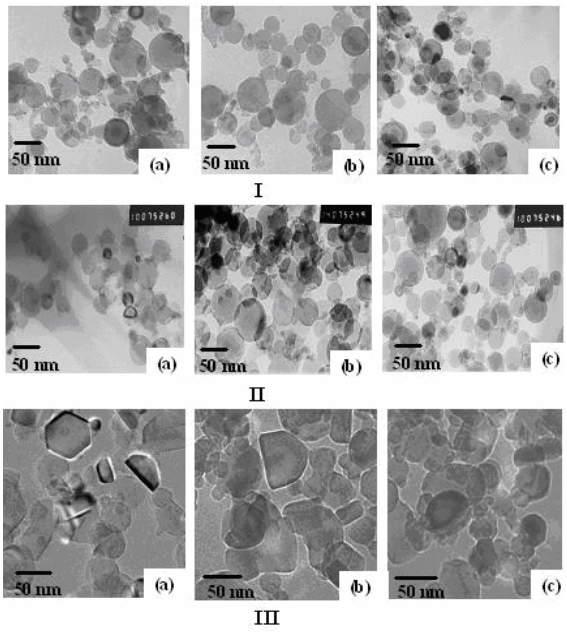
Dynamic Mechanical Analysis of Epoxy Nanocomposite (a) Storage Modulus (b) tan(δ)

(f) Sterilization of Liquid Food using pulse power technique.

Sterilization of liquid foods by pulsed electric field technique is one of the important ongoing research activities in High voltage laboratory, IIT Madras. This work has been initiated with the financial support from Department of Bio-technology, Govt. of India. The aim of the work is to identify the compact cost-effective and reliable pulsed voltage source and to formulate a simple methodology to improve the shelf life of the liquid foods.

(g) Production of Nano Powder by Wire Explosion Process

Generation of nano particle by wire explosion process is one of the major areas of research in this laboratory. The research work is on production of nano aluminium particles for its potential use in rocket propellants.



Typical TEM Structure of the Nano Aluminium Particle Produced in Different Ambience (I) Helium (II) Argon (III) Nitrogen (a) 0.025MPa (b) 0.05MPa (c) 0.1MPa

One of the key findings is that by exploding the wire in binary gas medium, it is possible to produce particle size distribution skewing to the left. The research work is in progress in collaboration with Extreme Energy Density Laboratory, Nagaoka University, Japan initiated by Prof. Kiyoshi Yatsui. Now we are trying to understand the mechanism of nucleation of nano particle at different atmospheres and influence of local temperature variation on nucleation of nano particle.

Research work at other laboratories

Very recently, *Dr. Nilesh J. Vasa* has joined as a faculty member in the Precision Engineering and Instrumentation Laboratory at the Department of Mechanical Engineering. Previously he was at Kyushu University, Fukuoka, Japan where he was working in the areas related to development of tunable solid-state lasers and their applications to gas sensing, nonlinear optical effect combined with electro-optics, diode laser application to electric field, electric current sensing, and Experimental study on lightning attachment manner considering various types of lightning protection measures on wind turbine blades. Currently, at PEIL micro-electro discharge machining of silicon is being studied. He also intends to develop laser based, remote sensing techniques for high voltage industry applications.

Conclusion

As a head of the high voltage laboratory, IIT Madras, I am pleased to share my experience that it is possible to carryout state of the art research work for innovating new ideas and realize its practical applications through collaborative research. It is appropriate to mention here that High voltage Research Laboratory and Precision Engineering and Instrumentation Laboratory at IIT Madras has close association with professors at various universities in Japan. We are earnestly looking forward to enhance the scientific collaboration between IIT Madras and various research laboratories in Japan to work in the emerging research areas of High Voltage Engineering. I personally invite the researchers to pay a visit to our high voltage laboratory, IITM so as to strengthen our scientific collaboration.

Acknowledgement

The author wishes to thank **Nilesh J. Vasa,** Department of Mechanical Engineering, IIT-M and **Dr. Noriyuki Hayashi**, Kyushu University, Japan for giving an opportunity to write about the high voltage laboratory activities at IIT-Madras, India.

TECHNOLOGIES FOR TOMORROW

Improvement for Diagnosing Internal Abnormalities in Oil-filled Transformer

1. Introduction

The dissolved gas analysis process is among the most widely practiced methods of diagnosing internal transformer faults. A mix of dissolved gas extraction technology and gas chromatography; the process has been verified as an effective way of localizing internal transformer faults; with large volumes of supporting data collected from field testing to obtain reliable long term target gas analysis technology.

The traditional dissolved gas analysis method of identifying fault modes and troubleshooting helps distinguish between discharge and overheat modes, but performs less well in localizing faults between the winding and iron core that could lead to a transformer shutdown.

Faults occurring in the iron core empirically account for more than 90% of the causes of gas generation. Faults in the winding should require immediate intervention because they could develop into dielectric breakdown accidents. Further, because faulty transformers need to be brought into shops for internal checks and repairs, their extended periods of unavailability used to bother the workshops in charge of their maintenance.

A gas generation test has been conducted on full-scale models to devise a method of locating overheated parts using data collected by the former method. The traditional dissolved gas analysis process has been coupled with this method to obtain potentially improved accuracy with which to locate overheating in transformers.

2. Development of Overheating Abnormality Diagnostic Methods

Three winding and four core models were selected as experimental models(an example is shown in Fig.1), with reference to those events that were undetectable by external diagnostics, such as on-site electrical testing, among the problems reported by Japanese utilities and previous gas generation incidents.

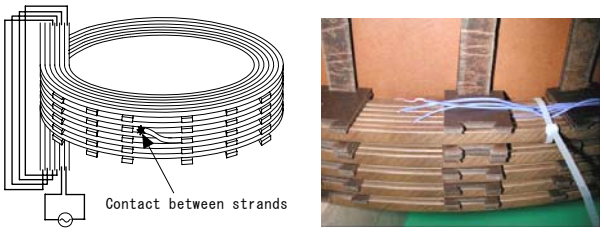


Fig.1 Helical winding model

Accordingly, the component ratio of C_2H_6 (ethane) to C_2H_4 (ethylene) was determined with regard to each set of experimental data, the equivalent overheating temperature and area respectively were estimated by solving the following equations:

- Estimation of equivalent overheating temperature T

$$T=320\times\log(C_2H_4/C_2H_6)+530$$

- Estimation of the equivalent overheating area S

$$S=(Qoil\times C\times 10^{-3})/(30\times 24\times K)$$

where

Qoil:Transformer oil volume (Lit)

C:Rate of rise in the total combustible gas (TCG) (ppm/month)

K:Rate of gas generation (ml/cm^2×h)

The rates of gas generation are:

$\log(K)=14-12000/(T+273)$ $T>562$

$\log(K)=5.5-4900/(T+273)$ $562>T>285$

$\log(K)=1.2-2500/(T+273)$ $T<285$

The equivalent overheating area of each model was worked out by solving the above equation and then plotted along the abscissa of the horizontal axis in a graph shown in Fig. 2, with the C_2H_4/C_2H_6 ratio along the ordinate to review characteristics of the process of gas generation in the model.

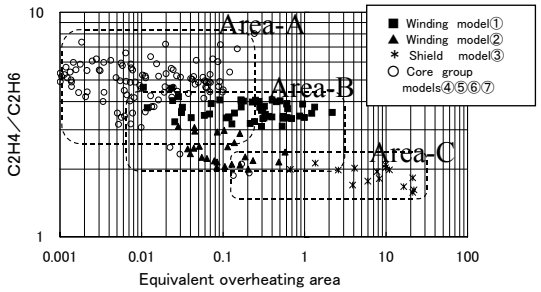


Fig.2 C_2H_4/C_2H_6 ratio and equivalent overheating areain experimental model

Transformers that had previously generated dissolved decomposition gases in overheat mode, with the causes of such gas generation identified by either internal checks or overhauls, were subjected to similar analyses to the experimental models.

Fig. 3 plots data obtained with these transformers in a graph of the equivalent overheating area and the C_2H_4/C_2H_6 ratio as in Fig2.

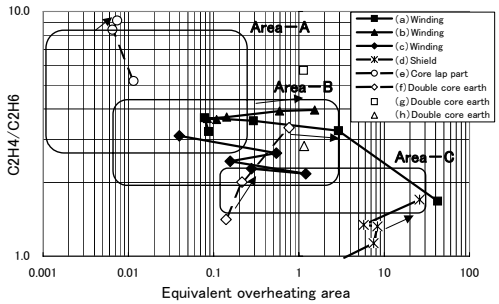


Fig. 3 C_2H_4/C_2H_6 ratio and equivalent overheating area in past examples

A small nunber of data is available on actual transformers but essentially correlates with the experimental models in terms of the rate of gas generation from the winding group. Also with the core group, the rate of gas generation from their tank magnetic shields resulting from core sheets falls within the same range as in the model experimental findings.

Based on the latter, the transformers tested were found to be in good agreement with past records, except for double-earth core modes.

3. Application to Diagnostics

Diagnostics were carried out in diagnostic diagrams as delineated in Fig. 4; based on model experimental findings. Gas analysis data from actual equipment was plotted to find out where faults were located; the core or the winding.

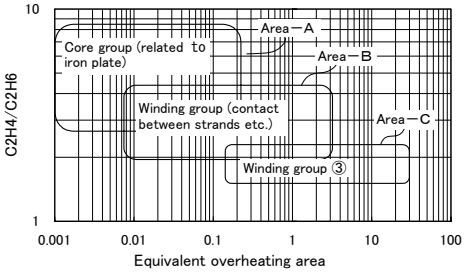


Fig. 4 Diagnostic figure by the ratio of C_2H_4/ C_2H_6 and equivalent overheating area

Based on the model experimental findings and gas analysis data on actual equipment, gas generation trends also provided criteria that aided in distinguishing faults between core and winding-group transformers. Trends in the rate of gas generating relating to the iron sheet in a core group transformer highlighted a smaller equivalent overheating area.

To distinguish faults between core and winding-group transformers, a diagnostic table was prepared in a combination of equivalent overheating area thresholds by breaking down the gas generation trends into four categories. Table1 shows an example of the diagnostic table.

Table 1. Diagnostic table based on gas trend.

Equivalent overheating area	Gas trend: Rate of rise is constant	Stop after rapid rise	rapid rise at some point	Rate of rise expands guradually
Under a constant number	High possibility of iron core group faults	High possibility of iron core group faults	High possibility of iron core group faults	Incipience of winding group or an iron core group faults
Over a constant number	Possibility of winding group or double core earth faults	Possibility of double core earth faults	Possibility of winding group or double core earth faults	High possibility of winding group faults

This diagnostic method has been applied from May 2003, as a result of internal checks of seven transformers that had demonstrated increases in the total combustible gas, six transformers were daignosed correctly.

A correct diagnostic example as winding faults is shown in Fig.5 and Fig.6. A main cause of a wrong diagnostic example was the overheating of the core group through several sheets of insulating papers. It is a problem in the future.

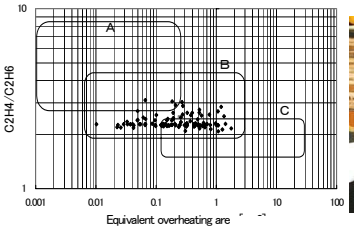


Fig. 5 The diagnostic of Actual transformers

Fig. 6 The inspection of an actual transformer

4. Conclusion

The model experimental findings, coupled with gas analysis data on actual transformers, indicated that core and winding-group transformers yielded different sets of trends in their rate of gas generation, equivalent overheating areas and C_2H_4/C_2H_6 ratios; even when they generated gases in overheat mode, suggesting a diagnostic method useful for enhancing the accuracy with which to locate overheats in transformers.

This practice will not only prevent accidents in electrical power systems for enhanced system reliability and promise enhanced economics through the implementation of optimally timed repairs but will also allow better utilization of assets.

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Material Recycling of Silane Cross-linked Polyethylene Insulated Cable Using Supercritical Alcohol

Introduction

Silane cross-linked polyethylene (Si-XLPE) is widely used for insulation of wires and cables. Most of industrial waste of the cross-linked polyethylene is burned as fuel. But material recycling is more favorable for environment.

Material recycling of Si-XLPE is hardly to be accelerated because it is not thermoplastic. If the cross-linking element will be decomposed selectively, we will get the thermoplastic polyethylene (recycled PE) from the Si-XLPE waste.

In this article, we show the new technology to get recycled PE from Si-XLPE by chemical reaction in supercritical alcohol. Moreover, the new continuous process of supercritical fluid for polymer which use extruder was developed. Mechanical and electrical properties of recycled polyethylene were good enough for insulation of 600V rating XLPE cable.

Chemical Reaction

Chemical reaction in the supercritical alcohol is shown in Fig.1[1]. Siloxane bond (Si-O-Si) can be decomposed to alkoxide group (-OR) or hydroxyl group (-OH) by supercritical alcohol selectively. The schematic phase diagram is shown in Fig.2. It is called supercritical fluid that the temperature and the pressure of the materials are higher than critical points. Critical points of water and alcohol are shown in Table 1. Critical temperatures of the alcohol are lower than that of water.

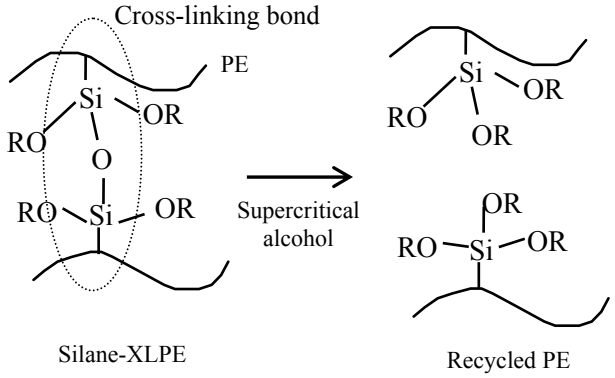


Fig.1 Chemical reaction of crosslinking bond in supercritical alcohol

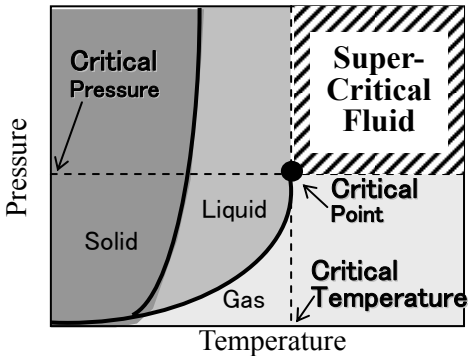


Fig.2 Schematic phase diagram

Table 1 Critical points

Material	Methanol	1-propanol	Water
Temperature(℃)	240	264	374
Pressure(MPa)	8.0	5.1	21.8

Process Development

One of the most important subjects of the supercritical fluid technology is development of the industrial process for the solid material. In the general process for the supercritical fluid, the solid material was crushed into the small particle and dispersed in the solvent to make a slurry. Then, liquid pump is used to feed the slurry but this kind of process has the problem for the industrialization as follows. It is required much cost to crush the materials into particle to make powder for slurry. Moreover, the process requires much solvent more than solid material itself.

To solve this problem, we developed the new continuous process for the supercritical fluid using extruder. Extruder was used as the processing machine for polymers. Pressure and heat can be applied to the polymer with the extruder. The polyethylene which is crushed into 2 to 3mm in diameter can be fed to the new process. It means that the new process does not require to make powder of solid material. Furthermore, minimum amount of supercritical fluid is required for the chemical reaction into pressurized polymer.

The schematic diagram of the new continuous process using extruder for supercritical alcohol is shown in fig.3.

It is used here that the crushed Si-XLPE waste which come out from the process making cross-linked PE cable. The gel fraction of Si-XLPE waste was 31%. Si-XLPE was fed to the hopper of continuous process. Twin screw extruder made by Japan Steel Works was used as equipment for chemical reaction (Ext-Chem) and degas (Ext-Degas). One-way valve was attached to the cylinder of the Ext-Chem to inject the supercritical

1-propanol. The 1-propanol was pressurized by high pressure liquid pump and heated to the supercritical state to be 10phr per 100phr of Si-XLPE before it was injected to the cylinder.

The condition of reactor zone was kept the supercritical state for 20min. Pressure control valve was connected to the front of the reactor.

Ext-Degas was mounted to the outlet of the intermediary pipe to separate recycled PE and 1-propanol. In Ext-Degas, the recycled PE was send to the die by screw but the gas of 1-propanol was retrieved by the vacuum pump of the vent of the extruder.

Then the strand of the recycled PE was extruded and cooled in the strand cooler. Finally, strand is cut into the pellet.

As it was explained, this process make it possible to get the recycled PE from Si-XLPE automatically.

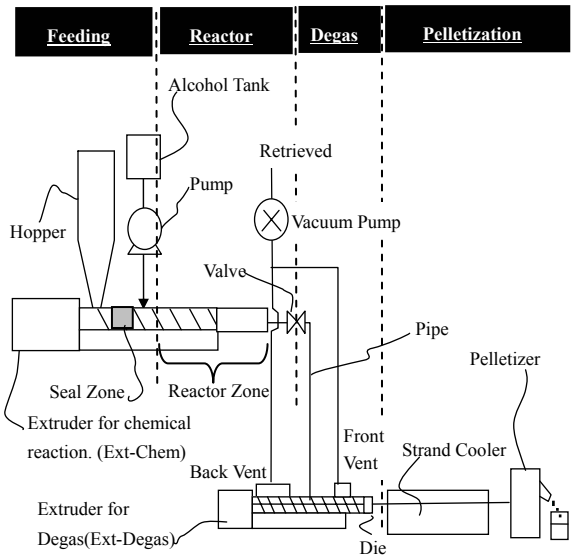


Fig.3 Schematic diagram of continuous process for silane-XLPE using supercritical alcohol.[2)]

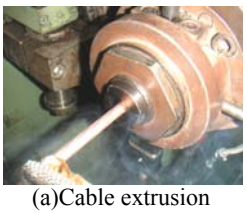
The properties of the recycled PE was shown in table 2[3)]. The gel fraction of recycled PE is 0%. This means that cross-linking is completely decomposed. The mechanical properties of the recycled PE satisfy the JIS C3605(Japan Industrial Standard for the 600V rating XLPE cable).

Table 2 Properties of recycled PE

Tensile strength at break (MPa)	18.3
Elongation (%)	660
Gel Fraction (%)	0

XLPE cable made by recycled PE

Apearance of Cable extrusion of recycled PE and the 600V rating XLPE cable(Cross section of conductor 38mm^2, Thickness of insulation:1.2mm) was shown in fig.4. The proccessability of recycled PE was good enough to be used as the insulation of cable.



(a)Cable extrusion

(b) Recycled 600V rating XLPE cable

Fig.4 Trial for cable recycling

The properties of the recycled cable was shown in table 3. The initial mechanical and electrical properties of the cable satisfied the JIS C3605.

Table 3 Properties of the recycled cable

Items	Recycled Cable	Required
Tensile Strength at break(MPa)	20	>10
Elongation(%)	500	>200
Insulation Resistance(MΩ・km)	1.0×10^5	$>1.5\times10^3$
Breakdown Voltage(kV)	28	>2.5
Heat Deformation(%)*	0.9	<40

* : At 120℃ under the force of 20N.

Conclusion

Recycling technique of Si-XLPE of the wire and cable was investigated. Cross-linking element can be decomposed selectively by supercritical alcohol. The new continuous process using extruder for supercritical fluid is useful for the recycling of Si-XLPE. The properties of the recycled PE indicated that the recycled PE can be used as the insulation of wire and cable. These results suggest that the recycling from cable to cable will soon be available.

References

1) T. Goto etc. Japanese J. Polym. Sci. and Tech. Vol.58, No.12 pp.703-709 (2001).
2) T. Goto etc., Kagaku Kogaku Ronbunsyu,Vol.31,No.6, pp.411-416(2005)
3) T.Goto etc. J. of the insititute of Elec. Eng. of Japan-Vol.126B, No.4, pp.400-406(2006)

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Development of High Thermal Conducting Insulation for Turbine Generator Stator Coil

Introduction

There has been increasing demand for turbine generators that are easy to maintain and have low life cycle cost. Indirectly hydrogen-cooled turbine generators (IH-TG) have met these needs in electric power generation applications, and they have simpler structures than directly water-cooled generators (DW-TG). However, the inferior cooling performance of their stator coils limits their capacity.

To overcome this problem, we have developed high thermal conducting (HTC) insulation, which has enabled us to manufacture a large-capacity IH-TG (more than 560MVA) for the first time in the world.

Subjects of increasing capacity in IH-TG

Fig.1 shows a part cross sectional view of an IH-TG stator. The heat generated in the stator coil conductor is transmitted to the core through the insulation layer [1].

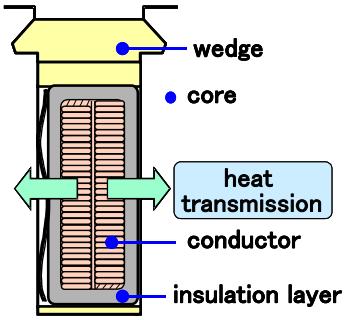

Fig.1 Cross sectional view of a part of stator

As shown in Fig 2, the thermal conductivity of the insulation layer is the lowest of the three materials. Thus, an insulation layer with increased thermal conductivity would greatly improve cooling performance.

HTC Insulation

1) Concept

The requirements of the new insulation are as follows:

1. Twice the thermal conductivity
2. Equivalent insulation performance
3. The same production facility
4. Non-hazardous to human health

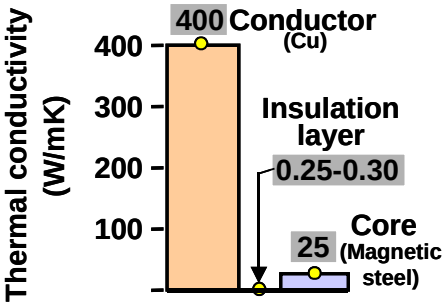

Fig.2 Thermal conductivity

2) Subjects

It has been reported that filling the insulation layer with HTC powder improves thermal conductivity but reduces the coil's voltage endurance performance [2]. However, the thermal conductivity must be consistent with electrical performance.

3) Performance

Material, particle size and amounts of HTC powder in the insulation layer have been investigated to meet this requirement.

The thermal conductivities of the developed HTC insulation layer removed from production-quality stator coils show twice the thermal conductivity of the conventional one, as shown in Fig. 3 [3].

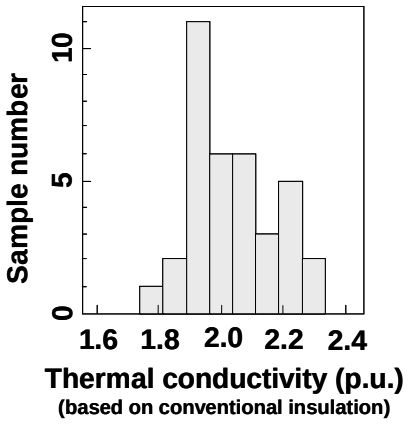

Fig.3 Thermal conductivity of developed HTC insulation

As shown in Fig.4, the developed HTC insulation shows the same voltage endurance life as the conventional one [3].

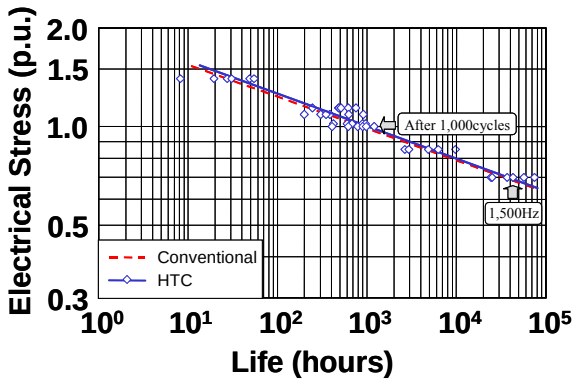

Fig.4 Voltage endurance life of HTC insulation coil

Evaluation of cooling performance of turbine generator with HTC insulation

We compared the temperature rises of IH-TGs of the same 350MVA class and the same frame size with HTC insulation and with conventional insulation.

As shown in Fig.5, the IH-TG with HTC insulation showed a remarkable temperature rise reduction (approximately 10 degree C) [3].

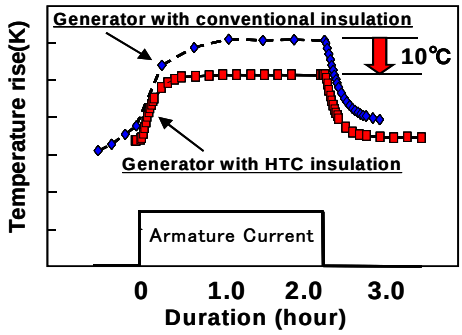

Fig.5 Temperature tests at rated stator current three-phase short circuit

Design impacts of HTC insulation

Adoption of HTC insulation improves the power density (capacity / weight) or the efficiency of turbine generators. Tentative generator designs with both conventional and HTC insulation have been carried out. Fig.6 shows the relation between the power density and the stator coil temperature rise of a 600MVA class IH-TG. Twice the thermal conductivity improves the power density of IH-TG by approximately 10% for the same frame size and the same stator coil temperature rise [3].

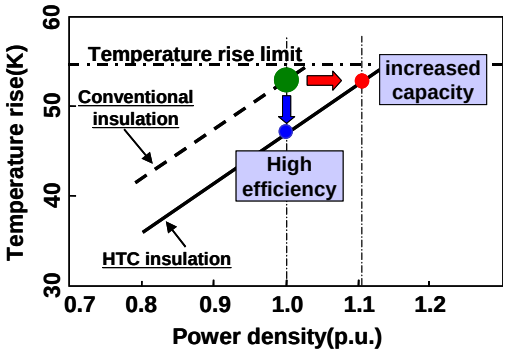

Fig.6 Impact of HTC insulation system on generator design

Conclusion

A new insulation system, HTC, has been developed that has twice the thermal conductivity as the conventional system. This new system provides a large-capacity IH-TG that has a simpler structure and is easier to maintain than a DW-TG. This enabled us to manufacture a 560MVA-class IH-TG in 2005.

The HTC insulation technology improves generator efficiency, increases generator capacity and simplifies coil cooling, enabling development of improved heavy electric apparatuses including turbine generators. Furthermore, the resulting improved generator efficiency contributes to environmental consciousness by conserving natural resources and reducing CO_2 emissions.

References

[1] S. Sekito, et al.: “Development and application of high thermal conducting insulation for turbine generator stator coil”, the thermal and nuclear power No.560 vol.54,(2003)

[2] C. –E. Stephan, et al.: ”An Improved Insulation System for The newest Generation of Stator Windings of Rotating Machines” ,CIGRE(1994) 35th vol.1, 11-101(1994)

[3] M. Tari et al.: “HTC Insulation Technology Drives Rapid Progress of indirect cooled turbo generator unit capacity”, IEEE PES summer meeting(2001)

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MISCELLANEOUS

Photos on Front and Rear Covers

Front Cover:

Commissioning of 22.9kV, 3-phase Superconducting cable (Gochang, Korea)

As a case study on the practical application of superconducting technology, the Korean Electric Power Corporation (KEPCO) has started to conduct research on the operation method of superconducting cables if they are put into practice, assuming a voltage of 22.9 kV, which is the power distribution level in Korea; a current of 1,250 A, which is five times the standard capacity of 250 A; and cables that can be installed in underground ducts with φ175 mm in urban areas.

The cable was manufactured and installed by Sumitomo Electric Industries, Ltd (SEI). The cable conductor and superconducting shield are formed by winding with bismuth-based superconducting wires manufactured according to the new "controlled over pressure (CT-OP)" method, which was also developed by SEI. For electrical insulation, the composite insulation method impregnating liquid nitrogen into PPLP® (Polypropylene Laminated Paper) is adopted. Three cable cores are stranded in a cryostat, which is composed of a double stainless steel corrugated pipe and thermal insulator maintained in a high vacuum state. The diameter of the cable including the outer sheath installed along the outer circumference of the cryostat is 135 mm.

The cable is installed in a tunnel in Gochang testing yard, located in with two 3-phase terminations at both cable ends. Cooling system is also installed to cool the cable with sub-cooled Liquid Nitrogen.

The cable passed a test after installation as applying at nominal voltage and current in April, 2006. and then was taken over to KEPCO. KEPCO is now planning to conduct long-term operations, heat cycle tests, etc. for technical and economic assessment of the cable.

In Korea, power transmission needs are growing extensively, especially in urban areas. Superconducting cable is considered to be one of the most promising ways to improve the stability and capacity of electrical transmission and distribution lines.

Takato Masuda
Sumitomo Electric Industries, Ltd. Osaka, Japan

Rear Cover:

Time-resolved simultaneous measurement of successive partial discharge (PD) light emission and current pulses in SF_6 gas mixture

(Kyusyu Institute of Technology, Japan)

Four successive PDs were generated between a needle to plane electrode system in $SF_6/N_2/CO_2$ gas mixtures at 0.4 MPa. As shown in Figures A and B, we have successfully obtained electrical and optical information on successive PDs with ns order time resolution. Namely, we have simultaneously measured PD current pulses, still image and intensity waveform of PD light emission, and time-resolved spectroscopy of the third and fourth PDs that took place at the slit position of the streak camera. From these simultaneous measurements of PDs, we can discuss and clarify the discharge

phenomena and mechanism leading to breakdown in gaseous dielectrics, especially in SF_6 gas and gas mixtures. These findings would contribute to development of insulation diagnosis technique for gas-insulated power apparatus and new gaseous dielectrics with low environmental impact.

Shinya Ohtsuka
Kyusyu Institute of Technology, Japan

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Vol. 126-A No. 11 (Nov., 2006)	**Special Issue on Nanocomposites**

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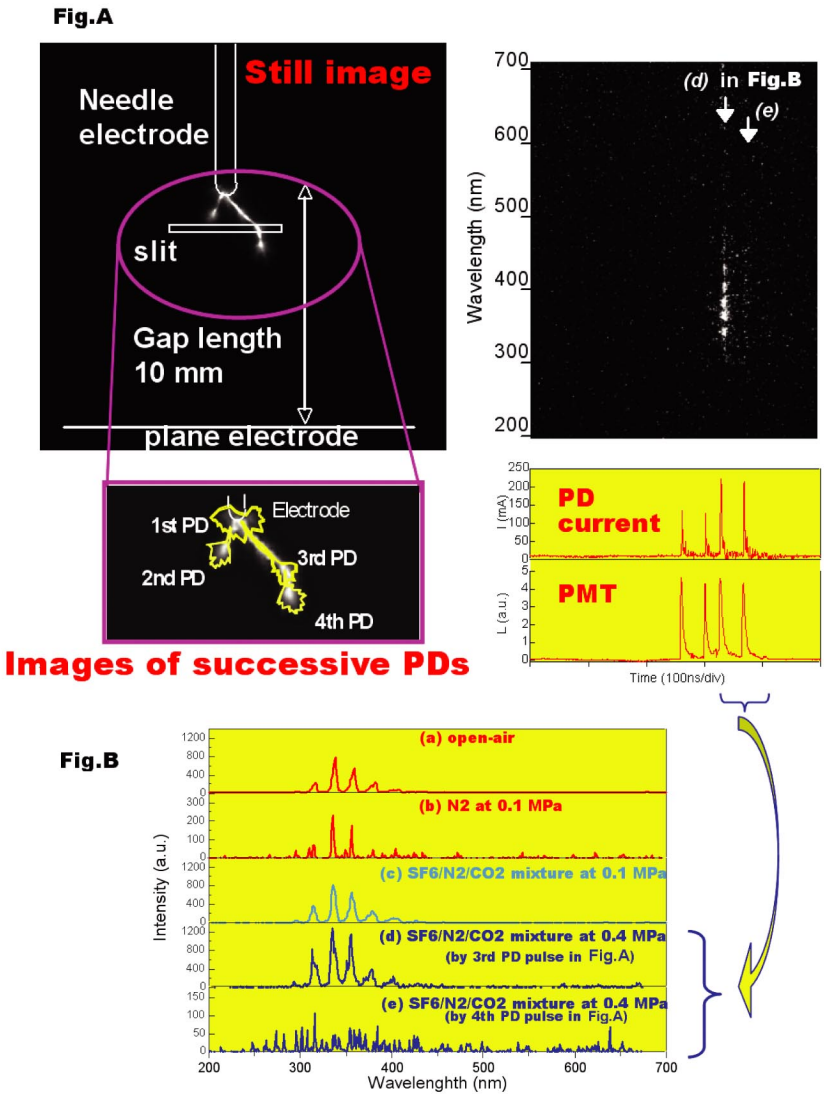

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