OUTLINE OF TECHNICAL COMMITTEES IN IEEJ

Dielectrics and Electrical Insulation (DEI)

Chairperson: Naohiro Hozumi (Aichi Institute of Technology)
Secretaries: Yasuhiro Tanaka (Tokyo City University)
Yuichi Ashibe (Sumitomo Electric Co. Ltd.)
Assistant Secretaries: Toshihiro Takahashi (CRIEPI)
Takahiro Imai (Toshiba Co. Ltd.)

Annual Symposium of Electrical and Electronic Insulating Materials and Applications in Systems (SEEMAS) and International Symposium on Electrical Insulating Materials (ISEIM) are important activities of TC-DEI. This year we held the SEEMAS, the domestic, in Matsue city, hosted by colleagues of Matsue National College of Technology. As well as the success of the ISEIM last year, this year's symposium was quite sensational.

Fig. 1 indicates that this domestic symposium used to be growing in its scale until the year of 1990. It is remarkable that the symposium maintained its scale even after our "bubble economy" collapsed. The symposium, however, turned into shrinkage after the year of 2000, correlating to the structural change in our economy. In 2006, the TC-DEI member started to reorganize the symposium. We aimed to promote the linkage between academia and industry, and encouraged the activity of young researchers. It is amazing that the number of participants has been increasing gradually since that time, and finally this year it has recovered to be the same level as the most active time. It is also quite impressive that, although the symposium was domestic, we had ten participants from Korea this year. We recognize that collaboration with Asian researchers is one of hot issues these days.

Nano-composite materials, insulation systems under inverter surges, space charge assessment, asset management regarding to insulation performance, outdoor insulations, thin dielectric films and other topics were discussed. After the symposium, we had the young researcher's seminar.

We will hold the domestic symposium again in 2010. The international symposium (ISEIM) will be held in the autumn of 2010 in Kyoto or vicinity, in cooperation with CIGRE SC-D1 colloquium. We are expecting your participation.

Fig. 1. Transition of attendants at the symposium. The expected transition after 2009 may be too extreme and not suitable to maintain the sense of affinity among attendants.

Fig. 2. The venue of this year's SEEMAS was idealistic that all participants spent three days in the same hall, in which both oral and poster sessions were held. We could freely visit poster booth during the intermissions of oral session.

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

Macro-view of DEI technology related
> Asset Management for Electric Power Equipments Based on Insulation Diagnosis (04/2008-03/2011, Chairperson: M. Ikeda (Nippon Petroleum Refining Co.)).
New materials including nano-materials related
> Physics of Organic Dielectrics/Semiconductors and Interfacial Design (04/2007 - 03/2010, Chairperson: M. Iwamoto (Tokyo Institute of Technology))
> Polymer Nanocomposites and their Applications as Dielectrics and Electrical Insulation (01/2006 - 12/2008, Chairperson: T. Tanaka (Waseda University)). Next activity is being planned.

Ageing and diagnosis of electric and electronic equipment related
> Degradation Diagnosis Technology based on Characteristics of Insulation Materials in Electric Power Apparatus (04/2007 - 03/2010, Chairperson: Y. Ehara (Tokyo City University)).
> Partial Discharge Measurement Under Repetitive Impulse Voltage Application (08/2007 - 07/2010, Chairperson: M. Hikita (Kyushu Institute of Technology)). The committee is cosponsored by the TC-DEI and TC of Electrical Discharge.

Basic dielectric and breakdown phenomena related
> Standardization of Calibration and Development of Application on Space Charge Measurement using PEA Method (03/2009-02/2012, Chairperson: Y. Tanaka (Tokyo City University)).

Electrical Discharges (ED)
Chairperson: Masayuki Hikita (Kyushu Institute of Technology)
Vice-chairperson: Toshiki Nakano (National Defense Academy)
Secretaries: Fumiyoshi Tochikubo (Tokyo Metropolitan University)
Akiko Kumada (University of Tokyo)
Assistant Secretaries: Yasushi Yamano (Saitama University)
Mina Sakano (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 1 currently run five 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 six domestic technical meetings on electrical discharges every year. In these meetings, about 200 full papers are presented in total from both academic and industrial sides by researchers, engineers, professors and students. The domestic technical meetings are sometimes co-organized by other Technical Committees on such as High Voltage Engineering, Pulse Electromagnetic Energy, Plasma, and Dielectric /Electrical Insulating Materials.

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 and has been held every two years. The next J-K Symposium is held on the November 5-7 of 2009 in Busan, Korea. The special issue of this symposium will be published in the IEEJ Transactions on Fundamentals and Materials IEE Japan in October of 2010.

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.
Technical Committee on Electrical Wire and Cables (TC-EWC) is a committee organized to support the IEEJ Power and Energy Society, and comprises members from universities, power utilities, the JR railway company, Japan Electric Cable Technology Center (JECTEC) and cable manufacturers. The technical committee organizes technical meetings to promote R&D activities in this field and provides an opportunity to present technical achievements. Three technical meetings were so far held in 2009. A technical meeting on deterioration diagnosis and online monitoring system was held as a joint meeting with TC-DEI on February 19 in Tokyo. A symposium on technical trends in measures for age deterioration of electric wires and cables was held on March 19 in Sapporo, Hokkaido. A discussion meeting on environment-friendly technologies for resins was held on August 18 in Tokyo. The technical committee plans to organize 4 more meetings in FY2009.

In addition to organizing such technical meetings, the technical committee supervises investigation committee dealing with subjects relating to electrical wire and cables. During the last several years, Investigation Committee for Technology of Wires and Associated Accessories for Overhead Transmission Lines, Investigation Committee for Accessories for 66kV and Higher Voltage XLPE Power Cable, and Investigation Committee for Technology of XLPE Power Cable and Associated Accessories for Underground Distribution were organized. This year, two investigation committees are in action as listed in Table 1.
Plasma Science and Technology (PST)

Chairperson: Ken Yukimura (Doshisha University)
Scientific Secretary: Kungen Teii (Kyushu University)
Scientific Secretary Assistance: Hiroshi Akatsuka (Tokyo Institute of Technology)

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. In 2009, four technical meeting were held; in June at Saga University in Saga, in August at Doshisha University in Kyoto, in September at Osaka Prefecture University in Osaka, in November at Tokyo City University in Tokyo. In 2008, five technical meetings were held. At each symposium, about 20 or 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 International Symposium on the Basics and Applications of Plasma Technology) had been held in Taiwan in collaboration with Japanese domestic societies related to plasma science and technology since 1999. Recently, APSPT-5 was held in Kaohsiung in Taiwan in December, 2007. Aiming at more flexible management, APSPT became sponsorship by the international organization committee from APSPT-4. While many members of TC-PST participate in the international organization committee, TC-PST continues playing a role important as a support organization.

APSPT-6 (http://apspt6.must.edu.tw) will be held at Mingshin University of Science and Technology, Hsinchu, Taiwan, R.O.C. in December 14-16, 2009. Several invited lectures and over 120 contribution papers are going to be presented in this symposium.

TC-PST currently runs two investigation committees as shown in Table 1. Here we introduce their activities. In the committee of the plasma–water applications and their reacting processes involved in liquid interfaces, various types of discharge-plasma applications have been systematically investigated by the experts in this field to deepen the understanding of plasma–water interacting phenomena at liquid surface boundaries. This comprehensive research covers the decomposition of persistent organics, the microorganism disinfection and the material synthesis. In the committee of the kinetic description of low-temperature plasmas with applications to modeling and simulation, with the widespread use of low-temperature plasmas in the field of energy conversion and environmental control, development of numerical models incorporating physical and chemical phenomena play a key role. The goal of this committee is to provide recent advances in plasma kinetic theory and its potential impact on their work. In 2009, authoritative researchers will summarize how they use plasma simulations.

The investigating committees dispersed recently, the plasma ion intensive use process investigation committee, the microwave plasma investigation committee, and the advancement of metal sputtering plasma committee had published their investigation as hard cover books, and it was useful for these books to systematize the newest technology trends of these fields.

(presented by Kungen Teii, Kyushu University)

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Pulsed Electromagnetic Energy (PEE)

Chairperson: Eiki Hotta (Tokyo Institute of Technology)
Vice Chairperson: Koichi Takaki (Iwate University)
Scientific Secretary: Sunao Katsuki (Kumamoto University)
Scientific Secretary Assistance: Shinji Ibuka (Tokyo Institute of Technology)

Pulsed electromagnetic energy produced by pulsed power, which refers to huge power within an extremely short period of time. The power level reaches 300 TW in the world largest pulsed power machine, Z accelerator in Sandia National Laboratory, USA. The period of time goes down to sub-nanosecond range. Pulsed power is often focused in a narrow space to produce an extremely high power density. Pulsed power is basically produced by means of a rapid energy transfer from an energy storage medium to the load. The pulse power technology and the pulsed electromagnetic energy have greatly expanded their regimes in technological and application fields, based on the state-of-the-art technology of power devices. Trend of the device is shifted from a single-shot huge machine to highly repetitive compact devices.

The research field of the Technical Committee on Pulsed Electromagnetic Energy covers the electric power engineering, plasma and discharge engineering, high energy density physics, accelerator engineering, bio-medical engineering and also pulse power device itself. By the modification of pulsed electromagnetic energy, we can make an extremely high energy density (high temperature and/or high density) state with well defined condition, which can be utilized for generations of high power lasers, intense radiation sources, high current particle beams and also for formation of new materials. The pulsed power technology is also capable of efficiently producing non-thermal equilibrium plasmas. A large volume, atmospheric pressure non-thermal plasmas is utilized for decomposition of toxic gases, ozone synthesis and sterilization. The pulsed power driven underwater discharges can be utilized for cleaning the water environment. The pulsed power discharges in composite matter are used for the recycling of aggregate in concrete blocks and of electronic parts in circuit board.

Recently, application of pulsed power to biological targets and its applications, which are called “bioelectrics”, has been glowing since 2000, in USA, Europe and Japan. The Investigation Committee on “Biological Effects of Pulsed Electromagnetic Energy and Their Innovative Applications” was established in January 2009. Since bioelectrics has a multi-disciplinary nature, this committee provides a forum to discuss important technical developments, their applications, increased understandings, new trends, and also future prospects in the interdisciplinary field. It is predicted that new knowledge should open an innovative application in wider field such as biotechnology, medical engineering, environmental engineering, agriculture and food processing. Here we introduce a couple of topics in the field of pulsed electromagnetic energy and pulsed power technology.

(1) Highly repetitive pulsed power technology

Industrial use of pulsed power requires highly repetitive and stable operation with the minimum maintenance effort. Also the device is preferred to be small as possible. Recent progress in semiconductor power devices and in ferromagnetic materials enables us to satisfy the requirement for the industrial use. There are various schemes to generate pulsed power. Figure 1 shows 1 J, 70 ns all solid state pulsed power generator, which is commercially available. The voltage and repetition rate can be easily adjusted up to 40 kV and 2 kHz, respectively. A compact Marx generator comes to be operated repetitively by replacing the traditional gaseous switches with fast semiconductor power devices. A fast recovery semiconductor diode is used as an opening switch to generate the ns-long induction voltage. The commercial availability of silicon carbide (SiC) power devices accelerates the industrial use of pulsed power and the expansion of the application field.

(2) Bright radiation source:

Pulsed power driven high energy density plasmas can be bright radiation sources. Pulsed power driven vacuum tin discharge is one of the candidates of the high power extreme ultraviolet (EUV, 13.5 nm) source for next generation semiconductor nano-lithography. In order to achieve the huge EUV power of 200 W, it is required to repetitively produce sub-mm size hot dense plasmas. The repetition frequency is needed to exceed 20 kHz. Also handling the huge thermal load is one of most important issues. Rotating disk electrodes and laser assisted tin vapor jet formation are the most promising technologies to solve the issues, as well as the high rep-rate pulsed power technology.

Fig. 1 Highly repetitive compact pulsed power generator for industrial applications.
(3) Gas treatment:

The sub-10 ns pulsed power is capable of efficiently producing non-thermal large volume plasmas in atmospheric pressure gases since only electrons are given a high energy from the field in the period of time. A large number of high energy electrons collide with neutrals to produce chemically active species such as radicals, ions, excited state molecules. These active species react with harmful components for human health or environment, as the result, the harmful components is decomposed and changes to harmless components. The pulsed power discharge plasmas in the atmospheric gas pressure are used for NOx (nitrogen oxide) removal from combustion exhaust gas, VOC (Volatile organic compound) decomposition and ozone synthesis in addition to the sterilization of medical appliances, surgical instruments and foods.

(4) Food processing:

Low temperature sterilization of liquid using intense pulsed electric fields (PEF) has been studied in the past tens of years to preserve ingredients of nutrition. However, the PEF sterilization is implemented in the limited cases since the PEF shows less effect on bacterial spores. Recent progress in pulsed power technology enables us to kill spores. Figure 2 shows the result of PEF sterilization of bacillus subtilis spores both by the 100 kV/cm PEF treatment and by the conventional heat sterilization. The contaminated liquid flows continuously between two parallel electrodes in a treatment vessel. Degree of sterilization, defined as log(N_0/N), depends on the treatment temperature both in the PEF and in the heat treatments, where N_0 and N are the initial and the surviving bacteria numbers, respectively. The bacterial spores are inactivated only for the temperature exceeding 100°C. The use of PEF lowers the treatment temperature by approximately 10°C, which help preserve ingredients of nutrition and flavor. Also the intense PEF is used to extract efficiently juice from plants. Cell membrane of target plant becomes permeable by applying PEF. This technology has been implemented and applied to sugar beets and grapes.

(5) Biological applications:

Non-thermal intense nanosecond pulsed electric fields (nsPEF) or narrowband burst radio frequency fields seemingly gives a unique stress to intracellular organelles and/or bio-molecules. Applying nsPEF is capable of inducing apoptosis to cancer cells, which will potentially be used for cancer therapy. Figures 3(a) and (b) show microscopic snapshots of intact HeLa cells and those exposed to an intense burst sinusoidal electric field (IBSEF, 2 kV/cm, 100 MHz, 1 ms). The pulsed cells are obviously inactivated. The time for doubling the number for the cells exposed to the field is approximately 35 hours, which is approximately 2 times as long as that of the sham control. Other bio-chemical analysis using fluorescent molecular probes indicates a portion of the cells went dead via the process of apoptosis. Also ns PEF is capable of activating platelet, which can be applied for wound healing. Similarly the nsPEF induced biological stresses or stimuli will potentially be used for agricultural applications, such as seed germination, growth control.
Electromagnetic Compatibility (EMC)

Chairperson: Tsuyoshi Funaki (Osaka University)
Secretaries: Ken Kawamata (Hachinohe Institute of Technology),
Tomoo Ushio (Osaka University)
Yoshinori Taka (Nagoya Institute of Technology)

The Technical Committee on Electro-Magnetic Compatibility (EMC) has a vital role of researching following subjects;
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 these purposes the committee pays their attention to 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 security technology for electromagnetic wave and information.
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 noise immunity for electric and electrical appliances.
4. Investigation committee on EMC technologies for electrostatic discharge (ESD).

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

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

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

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

The committee holds some technical conferences. They were June 5th, Nov. 13th, Dec. 19th for 2008, and Jan. 21th, Mar. 6th for 2009. This year, the committee technically co-sponsored the 2009, international symposium on electromagnetic compatibility, Kyoto, which was held Jul. 20th-24th, 2009.

1. Investigation Committee on Security Technology
for Electromagnetic Wave and Information

This committee has started its activity in April 2007. Dr. Shinji Seto of NICT is chairing this committee. The Objectives of the committee activity are followings

1. Surveying the security technology for electromagnetic wave and information, including needs, terminology, and standards,
2. Surveying the eavesdrop by TEMPEST like technology, including current status, documents, threat, and counter measurement,
3. Surveying the attacking by Intentional-EMI, including current status, documents, threat, and counter measurements.

The committee is focusing on establishing secure and safety world with preparing the adequate (not exceed) countermeasure for the prospective electromagnetic threats.

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 for taking over from the previous Investigation Committee on Electric Field and Current Induced in a Human Body Exposed to Electromagnetic Fields. 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 investigates 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. Especially, focused on simplified and rigorous methods;
4. Investigation of research subjects hereafter.

This committee concluded their investigative action on June 2009. The committee members are now get into writing final report.

3. Investigation Committee on Noise Immunity for Electric and Electrical Appliances

This committee, chaired by Prof. M. Tokuda of Musashi Institute of Technology, was established in Jan. 2008. The mission of this committee is to grasp and analyze the current situation of noise immunity for electric and electronics appliances and to clarify uncertainty of the measurement in immunity test. The investigation subjects are summarized as followings.

1. Standards and regulations on noise immunity for domestic and abroad;
2. Case examples and counter measure to the interference of noise;
3. Techniques for immunity tests;
4. Design and control technology for immunity.

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

4. Investigation Committee on EMC Technologies for Electro Static Discharge (ESD)

This committee, chaired by Prof. S. Minegishi of Tohoku-gakuin University, was established in Apr. 2008. The mission of this committee is to study the EMC issues accompanied with electrostatic discharge phenomenon, and clarify the factor for its origination and the mechanisms of the generation of wide band noise. The committee is working on the following subjects.

1. Survey the currently recognized terrors of ESD;
2. Measurement method of wide band current and electric field emitted from ESD;
3. Elucidate the mechanism in the occurrence of ESD, physically;
4. Modeling and simulation of ESD.

This committee envisions inspiring the other EMC engineers to recognize ESD problems as a sort of EMC incident.
Light Application and Visual Science (LAV)

Chairperson: Hiroyuki Kamei (Tokyo Institute of Technology)
Secretary: Takeshi Kinoshita (Keio University)
Susumu Kimijima (Covalent Materials Corporation)

Activities of the technical committee on light application and visual science (TC-LAV) have been covering fields of application of optical engineering and visual science for medical science, devices for visual information processing, light sources from far infrared to extreme ultraviolet, advanced lithography, and etc. Three investigation committees: ‘Future Technology of Infrared and Terahertz Waves (IC-FTITW)’, ‘Ultimate Technology for Lithography (IC-UTL)’, and ‘Technologies for Next Generation Light Source (IC-NGLS)’, are affiliated to this TC and are surveying the technology trend of each field. Two recent topics of light application are introduced.

The first topic is optically assisted ultrasonic velocity change imaging. In recent years, there has been extensive research related to the application of nanoparticles in medical diagnostics and treatment. This is because they show promise as markers of liposomes and dendrimers for transporting drugs. It is thus necessary to monitor the distribution of nanoparticles in living organisms.

Methods for externally detecting the sites where they accumulate using light absorption or light emission have been considered. However, it is difficult for these methods to obtain information of regions deep inside the living organisms, because biological tissue exhibits strong light scattering.

The method of mapping the absorption of scattered light in living organisms by ultrasound scanning has been proposed to image metabolic information in living organisms\(^3\). This method detects the ultrasonic velocity changes of medium associated with the near infrared light absorption. It is possible to visualize optical absorption sites deep inside the living organisms, because the ultrasound signal intensity does not depend on the light-scattering coefficient. This method is called "optically assisted ultrasonic velocity change imaging".

The objective of this study is to evaluate the potential as a drug delivery system monitor of nanoparticles using the optically assisted ultrasonic velocity-change imaging method. Gold nanoparticles are minute particles which are harmless to living organisms and exhibit a characteristic optical absorption spectrum due to their localized plasmon resonance. Gold nano-rods is the cylindrical nano particles and their absorption peak wavelength can be controlled by their shape (aspect ratio). The gold nano-rods used in the experiments showed the absorption peak at 820nm.

Figure 1 shows the experimental setup in this study. The center in the picture is the remodeled diagnostic ultrasonic equipment. This equipment is attached “the signal processing board” to transfer RF echo data to the personal computer. The experimental setup was applied to obtain the tomography of the phantom including gold nano-rods as an absorbing material. Figure 2 (a) shows the internal view of the phantom. The phantom was made of the chicken breast meat which contained nano-rods mixed with an agar-gel. Gold nanorods located at 10 mm depth of the chicken meat. The array transducer was set above the chicken meat. The laser diode operating at 809 nm which was close to the gold nano-rods absorption peak was used as a light source. Waveforms of RF signal of ultrasonic array transducer obtained before and after illumination were stored and their partial shifts were calculated by a personal computer. The ultrasonic velocity change images were constructed from the partial shift of waveform of every scan line. Figure 2 (b) shows the B-mode image of the phantom. From the B-mode image, it is difficult to detect the distribution of nano-rods gel. Figure 2 (c) shows the ultrasonic velocity change image which was taken at 30s in the exposure time. The distribution area of nano-rods appears clearly in the ultrasonic velocity change image.

Possibility as a monitor of nanoparticle distribution in living organisms was shown by experimental results. If the present imaging method is used as a drug delivery monitor of the gold nano-rods, it may be possible to obtain spatial information about malignant tumors in deeper regions.

The second topic is double patterning processes using the ArF immersion lithography. Further miniaturization of semiconductor devices is
strongly expected to realize more convenient and compact electronic systems. The downsizing limit of devices mainly depends on size limit of patterns replicated by lithography. Specifically speaking, the limit is almost decided by the resolution limit of the lithography tools and processes. According to International Technology Roadmap for Semiconductors (ITRS), patterns with a half pitch of 32 nm is required in 2013. The first lithographic candidate to attain the target is the double patterning processes using the ArF immersion lithography.

The ArF excimer laser wavelength of 193 nm in air becomes $\frac{1}{1.44}$ in water. However, the resolution $R$ calculated by the following equation is only 43 nm even if the $k_1$ factor is supposed to be as small as 0.3.

$$ R = k_1 \frac{\lambda}{NA} $$

(1)

Here, $\lambda$ is the wavelength and $NA$ is the numerical aperture of the projection lens. When $\lambda$ is 193 nm/$1.44 = 134$ nm, and $NA$ is 0.93, $R$ becomes to 43 nm.

To reduce $R$ to less than 32 nm, some other countermeasures are necessary. Double patterning is the method to print narrow-pitch patterns superimposing or transforming original wide-pitch patterns. At first sight, it seems that the method is easily performed by alternatively separating the original patterns into two groups, and printing each group patterns sequentially. However, it is not so easy to successfully print the narrow pitch patterns. Because, pattern widths had to be sufficiently slimmed or narrow to allocate another patterns in the interval spaces, although the pattern pitches were wide. In addition, doubly printed patterns had to be precisely aligned each other. For this reason, the resolution cannot be simply reduced in a half.

Typical double patterning method is shown in Fig. 3. In the first method shown in Fig.3, printed resist patterns are transferred to the hard-mask layer such as silicon oxide film using dry-etching, and another patterns are printed onto the resist over-coated on the hard-mask patterns. Besides this method, a lot of variations are proposed. Really useful methods will be selected hereafter. Several methods may coexist to effectively print different types of patterns, and depending on the serious concern of device-maker companies.

**Reference**

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, radioactivity, composites etc.

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 Study Meeting and the Investigation Committee under the TC-MC. The following introduces the recent Symposia in the National Convention of the IEEJ and Study Meeting under the TC-MC as shown in Table 1 and Table 2, respectively and the third 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. We previously provided new three technologies and related materials such the attractive carbon nano-tube, the fuel cell and the functional diamond except the superconductors.

Recent year, much attention has been paid on an investigation on advanced superconducting materials. The electrode materials for future batteries and fuel cells to be compatible with clean, green, renewable and sustainable society have been also focused.

The investigating R&D committee whose chairper son was Dr. Kumakura issued a technical report entitled "Fabrication and superconducting properties of advanced superconducting tapes and
wires”. This report won IEEJ outstanding technical report award in 2009. The forum using this technical report as a text book was held at CRIEPI on March 2008.

**Activities of investigation committee in TC-MC**

At present, there is one investigating R&D committee under TC-MC as shown in Table 3, the name of which is “Structure and composition of advanced superconducting materials”. The chairperson and secretary are Prof. Jyun-ichi Shimoyama (University of Tokyo) and Dr. Hiraku Ogino (University of Tokyo), respectively. Regularly, there are four meetings a year.

The meetings discuss fabrication technologies and evaluations on electromagnetic, thermal and mechanical properties mainly for Nb$_3$Al conductors, Bi-based oxide superconductors, MgB$_2$ conductors and Y-based oxide superconductors. Most expecting investigation results are fabrication technologies to obtain the high performance and its possibility at a viewpoint of microstructures and chemical composition for various superconducting materials such as Nb$_3$Al conductors, Bi-based oxide superconductors, MgB$_2$ conductors and Y-based oxide superconductors. And their cost performances as the practical superconductors and their applied technologies to such as persistent current mode-coils, cables, transformers, fault current limiters and so on. The committee is planning a study meeting related with the advanced superconducting materials on March 2010.

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<td>Development and problem of the high-efficiency solar cell</td>
<td>2009.03.19</td>
<td>Hokkaido University</td>
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<td>Metal and ceramic materials in energy strange systems (Planning)</td>
<td>2010.3.</td>
<td>Meiji University</td>
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<tr>
<th>Theme</th>
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<tr>
<td>Development of advanced superconducting wires and their future problems</td>
<td>2008.03.14</td>
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<td>Recent research progress in structure, composition and characterization of advanced superconducting materials</td>
<td>2010.3.</td>
<td>Suspense</td>
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<tr>
<th>Research Subject</th>
<th>Chairperson (Affiliation)</th>
<th>Period</th>
<th>Remarks</th>
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<tr>
<td>Wire and conductor forming of superconducting materials</td>
<td>Shirabe Akita (CRIEPI)</td>
<td>2001.10-2004.09</td>
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<td>Fabrication technologies and characterization of advanced superconducting materials</td>
<td>Hiroaki Kumakura (NIMS)</td>
<td>2004.10-2007.09</td>
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<tr>
<td>Structure, composition and characterization of advanced superconducting materials</td>
<td>Jyun-ichi Shimoyama (University of Tokyo)</td>
<td>2008.10-2011.09</td>
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The Technical Committee of Instrumentation and Measurement of IEEJ was set up in Jan. 1980, succeeding the Committee on Electronics Instrumentation and Measurement. 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. Fifteen members including chairperson, two secretaries, and an assistant-secretary constitute the committee.

ii) The workshops for the presentation and discussion of studies and researches take place almost every month in principle as a main activity of the committee.

iii) The visit of various professional facilities is planned to carry out once or twice a year. The actual subject issues in the workshop are the presentation and the discussion of extensive electronic instrumentation and measurement technologies including:

# Ultra-high speed measuring method employing optical technology
# Electro-magnetic measurement for ensuring EMC
# High precision measurement in frequencies and time domain for radio-controlled watches, GPS, and navigation
# Application of SQUID and MRI to bio-measurement
# Bio-electronic measurement applicable to the welfare field in society shifted to the aged
# Magnetic measurement related to magnetic sensors

# Resolving factors causing uncertainty and development of its reducing method for establishment of electrical standards

The workshops mainly take place at Tokyo area, and sometimes in Saga and Miyazaki (Kyushu Island), in Osaka and in others. The themes of presentation in the workshop are 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 70 titles. The workshop is supported by IEEE IM and sometimes by other organization.

Recently, the committee planed a special volume on “Measurement Technology for Safety” and then the volume including eight papers was published on August 2009. The titles and authors are as follows;

# Research into Warning Time Optimum Control for Level Crossing with a Continuous Type Train Location Detector using Crossed Inductive Wires (T. Matsumura & T. Ono)
# Real-Scale Measurement Results for Audible Noise from AC Overhead Transmission Lines and Prediction Formula in Heavy Rain (K. Tanabe)
# Development of Isolated Travel Sensor for High-voltage Switchgear (A. Shiratsuki, T. Mori, H. Kohyama, H. Nakajima, T. Nakashima, T. Oka, & K. Sumi)
# Flame Imaging for Safety Surveillance (T. Fukuchi)
# An Error Estimate of the VHF Broadband Digital Interferometer (Y. Nakamura, T. Morimoto, T. Ushio, & Z. Kawasaki)
# Continuous Measurement of Amplitude Probability Distribution and Applications to Pulses of Low Occurrence Frequency (S. Arakawa, S. Ronte, T. Otsuka, H. Aso, & M. Uchino)
# Suppression of Clutter near Port by S-Band Radar (S. Ishii & S. Sayama)
# Weathering State Independent Rock Type
Classification using Textural Features (E. Momma, H. Ishii, & T. Ono)

Our committee website (http://202.235.159.197/~aim/) also assists to understand our activity.

Written by Dr. Kazuo Tanabe (Central Research Institute of Electric Power Industry, CRIEPI), Chairman, e-mail: tanabe@criepi.denken.or.jp

The visit of SPring-8, which is a large synchrotron radiation facility which delivers the most powerful synchrotron radiation currently available and located in Harima Science Park City, Hyogo Prefecture, Japan, by the committee members October 2, 2009