OUTLINE OF TECHNICAL COMMITTEES IN IEEJ

Dielectrics and Electrical Insulation (DEI)

Chairperson: Yasuhiro Tanaka (Tokyo City University)
Secretaries: Masaaki Ikeda (JNES*)
Yoitzu Sekiguchi (Sumitomo Electric Co. Ltd.)
Assistant Secretaries: Norikazu Fuse (CRIEPI**) Takahiro Imai (Toshiba Corporation)

*JNES: Japan Nuclear Energy Safety Organization **CRIEPI: Central Research Institute of Electric Power Industry

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

Organized events by TC-DEI

The important activity of TC-DEI is the annual domestic Symposium on Electrical and Electronic Insulating Materials and Application in Systems (SEEIMAS), formerly called Symposium on Electrical Insulating Materials. The 44th SEEIMAS is to be held in Toyohashi city on November 25-27, 2013, with technically cosponsored by IEEE DEIS Japan chapter, CIGRE Japanese national Committee and locally arranged by colleagues of Toyohashi University of Technology. New materials and the improvement of their properties, functional materials, nano-composite materials, insulation systems under inverter surges, partial discharge and space charge assessment, outdoor insulations, thin dielectric films and other topics will be discussed. Especially in this year’s symposium, the special session featuring the diagnosis of electrical insulation degradation with demonstration using actual equipment is supposed to be carried out, and it must attract participants.

Following the 44th SEEIMAS, the 30th young researchers’ seminar will be also held in Mikawa area, near Toyohashi City, on November 27-28, 2013. While the seminar was used be mostly held with two years interval by 2001, it was not held for long time mainly because of the financial crisis in Japan. However, to activate the youth in this research field, the TC-DEI decided to bring back the seminar in 2009. The 30th memorial seminar will be held following the last seminar in 2009.

In every 3 years, we hold SEEIMAS as an international one technically cosponsored by IEEE DEIS, namely the International Symposium on Electrical Insulating Materials (ISEIM) with Honorary Chair of Prof. M. Nagao and the General Chair of Prof. Y. Tanaka, in June 1-5, 2013 at Toki Messe, Niigata, technically cosponsored by IEEE DEIS, co-sponsored by Niigata University and Waseda University, in cooperation with IEEE DEIS Japan chapter. The TC-DEI is now planning a new type special session concerning “Measurement of Space Charge Distribution using PEA system” to attract many participants. Information about the 2014 ISEIM will be updated on the following URL. Please visit there. We are expecting your participation.
http://www2.iee.or.jp/~adei/ISEIM2014/index.html

Investigation Committees run by TC-DEI

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

New materials including nano-materials related
> Nano-Materials and Structure Control for Organic Devises with New Function and High Performance (04/2011 - 03/2014, Chairperson: K. Kato (Niigata University)).

> Forefront of the Study of Organic Dielectrics, Conductive Electrical and Electronic Materials in the District of Asia (11/2010 - 10/2013, Chairperson: M. Iwamoto (Tokyo Institute of Technology)). Next committee is now under consideration.

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

Ageing and diagnosis of electric and electronic equipment related
> Investigation of Degradation Diagnosis Technology of Electric Power Apparatus for its Transfer (04/2013 - 03/2016, Chairperson: Y. Ehara (Tokyo City University)).

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

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

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

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

### Electrical Discharges (ED)

**Chairperson:** F. Tochikubo (Tokyo Metropolitan University)

**Secretaries:**
- A. Kumada (The University of Tokyo)
- H. Kojima (Nagoya University)

**Assistant Secretaries:**
- Y. Yamano (Saitama University)
- N. Shimura (Toshiba Corporation)

The Technical Committee on Electrical Discharge (TC-ED) belongs to the Fundamentals and Materials Society (A-Society) of the IEE Japan. The mission of the TC-ED is the wide promotion of the research activities concerning a variety of electrical discharges in vacuum, gas, liquid and on surfaces of materials and their applications to advanced technologies in various fields.

Several investigation committees are established every year to survey the up-to-date research subjects under the control of the TC-ED. The activities of these committees usually continue for three years. Three investigation committees in Table 1 are in operation.

The TC-ED organizes about six domestic technical meetings on electrical discharges every year. In these meetings, approximately 180 papers are presented in total from both academic and industrial sides by researchers, engineers, professors and students. The technical meetings play an important role for young researchers as a good training ground. The domestic technical meetings are sometimes co-organized with other Technical Committees such as Pulse Electromagnetic Energy, Plasma Science and Technology, Dielectric/Electrical Insulating Materials, High Voltage Engineering, and Switching and Protecting Engineering.

In order to promote the international activities in electrical discharges, the TC-ED has jointly organized “Japan-Korea Joint Symposium on Electrical Discharge and High Voltage Engineering” with KIEE Electrophysics and Applications Society every second year. The last J-K symposium was held jointly with the eighth International Workshop on High Voltage Engineering on November 16-17 2012 in Kanazawa. Next J-K symposium will be held in Korea in 2015.

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. The seminar in this year will be held on November 29 and 30, 2013.

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<th>Investigation Committees in TE-ED</th>
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<td><strong>Chairperson</strong></td>
<td><strong>Research subjects and established time</strong></td>
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<td>K. Satoh (Muroran Institute of Technology)</td>
<td>Atomic and molecular collision cross section and fundamental parameters of discharges (established in April 2011)</td>
</tr>
<tr>
<td>T. Oda (The University of Tokyo)</td>
<td>Electrostatic discharges as electromagnetic interference source (established in April 2011)</td>
</tr>
<tr>
<td>K. Miyagi (Kanazawa Institute of Technology)</td>
<td>Electrical/chemical behavior and application technology in dielectric liquids (established in October 2012)</td>
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Plasma Science and Technology (PST)

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

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

The major activity of this committee is to succeed to organize several technical meetings on plasma science and technology every year. In 2013, two technical meetings were held; in May at Nagaoka University of Technology in Nagaoka and in September at Nagasaki University in Nagasaki. In 2012, also four technical meetings were held. At each symposium, about 20–60 presentations are made. Presentations by young researchers in bachelor course and master course are strongly encouraged and appreciated. Some of the technical meetings are jointly organized with TC-PPT.

TC-PST currently runs four investigation committees as shown in Table 1. Here we introduce their activities. In the committee of atmospheric pressure plasma source for analysis of trace-order element, physics and chemistry of atmospheric pressure plasmas as well as their appropriate diagnostic methods and applications are being investigated. In addition, innovative technologies required for the various industrial applications are widely surveyed. In the committee of generation and application of metal vapor plasmas with high density and high ionization degree, upon the research outputs of the advancement of metal sputtering plasma committee held in 2006–2008, investigations are made over their characteristics, overview and perspectives to activate related research activities in domestic institutes. In the committee of the standardization of experiment and simulation modeling in liquid interface plasma, upon the research outputs of the advancement of the plasma–water applications and their reacting processes committee held in 2008–2010, investigations are made over the characteristics on plasma–water interface, overview and perspectives to activate related research activities in domestic institutes. Finally, in the committee of the propulsion performance of electrical propulsive rocket engine and its internal plasma physic phenomena, the progress of the propulsion performance and the understanding of physical phenomena in plasma are investigated by researchers of electrical engineering or plasma engineering.

Table 1. Investigation Committees in TC-PST.

<table>
<thead>
<tr>
<th>Committee</th>
<th>Duration</th>
<th>Chairperson</th>
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<tr>
<td>Atmospheric Pressure Plasma Source for Analysis of Trace-Order Element</td>
<td>3 years from 2010</td>
<td>A. Okino (Tokyo Institute of Technology)</td>
</tr>
<tr>
<td>Generation and Application of Metal Vapor Plasmas with High Density and</td>
<td>3 years from 2010</td>
<td>T. Ikehata (Ibaraki University)</td>
</tr>
<tr>
<td>High Ionization Degree</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Standardization of Experiment and Simulation Modeling in Liquid Interface</td>
<td>3 years from 2011</td>
<td>K. Yasuoka (Tokyo Institute of Technology)</td>
</tr>
<tr>
<td>Plasma</td>
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<tr>
<td>Propulsion Performance of Electrical Propulsive Rocket Engine and Its</td>
<td>3 years from 2011</td>
<td>K. Tahara (Osaka Institute of Technology)</td>
</tr>
<tr>
<td>Internal Plasma Physic Phenomena</td>
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</table>
The Technical Committee on Pulsed Electromagnetic Energy (TC-PEE) was founded under the Fundamentals and Materials Society of the IEE Japan in June 1999. The activity of TC-PEE covers the collection and spread of information on pulsed power technology and its applications.

The application of this technology now covers the following broad fields: new material development, thin film synthesis or ion implantation in industrial field; sterilization or medical treatment in biological and medical field; toxic gas decomposition and ozone or radical production in environmental field; nuclear fusion or particle beam accelerator technologies in energy field; and the destruction of rocks or concrete blocks in the civil engineering field and growth promotion of plant in the field of agriculture science. Thus the pulsed power technology becomes to be widely recognized as the basis of many technologies.

Recent activities of TC-PEE

The major activity of TC-PEE is to organize several technical meetings every year. In 2013, four technical meetings have been held or planned to be held, including the meetings in cooperation with the Technical Committees on Electrical Discharges or Plasma Science and Technology; in January at National Institute for Fusion Science (NIFS) in Toki, in May at Nagaoka University of Technology in Nagaoka, in August at Foundation for Computer Science (FOCUS) in Kobe, and in October at Kumamoto University in Kumamoto. In Kobe we visited the site of super computer KEI (see Fig. 1) after the technical meeting.

Presentations by young researchers are strongly encouraged and selected young researchers who make excellent presentations are awarded. In 2012, 6 students and young researchers recommended from TC-PEE were awarded.

Recent Activities of the Investigation Committee on Agricultural Applications Using Pulsed Power and Plasmas

This investigation committee is aimed to conduct an investigation on the present status of research and development in agricultural applications using pulsed power and plasmas. 22 committee members from various fields are chaired by Prof. Takaki. The activities are to hold regular meetings and symposiums in addition to the publication of the research report. Three of regular meetings have been carried out in the past one year. In each meeting, in addition of the regular presentations, a guest speaker from industry was invited in order to close the perspective gap between academia and industry. The attendee of meeting reached over 20 for each time. Two international meetings were supported by the investigation committee: the 9th International Bioelectrics Symposium (September 5-8, 2012, Kumamoto, Japan) and the 9th International Conference on Flow Dynamics (September 12-21, 2012, Sendi, Japan). 139 presentations were given in the former symposium, and 8 invited talks presented in the session named “Advanced Physical Stimuli and Biological Responses of Cells” in the later one. Other two symposiums will be held by the end of this academic year: “Research Innovation of Plasma-Agriculture Fusion Science” for the 30th Annual Meeting of the Japan Society of Plasma Science and Nuclear Fusion, and “Application of Pulsed Electromagnetic Energy for Agriculture, Fisheries and Foods” for the 2014 Annual Meeting of the Institute of Electrostatics Japan.

Fig. 1: Group photograph taken in front of the super computer KEI.

Fig. 2: The 9th International Bioelectrics Symposium held in Kumamoto.
Investigation Committee on the Status and Outlook of Pulsed Power Technology in Extremely High Power Level

In order to conduct a research on the progress and present status in ultra-high power level of pulsed power technology, a committee chaired by Prof. Horioka was also organized in January of last year until December of 2014. The topics are in its applications to high energy density physics, laboratory astrophysics, high power particle accelerators, energetic radiation sources, material science at extreme state, radiation hydrodynamics, intense plasma shock wave, and nuclear fusion science.

The committee meeting, the executive meeting, and the observation tour in the above research topics are held in the term. The photograph of the observation tour for the intense pulsed power devices in Extreme Energy-Density Research Institute, Nagaoka University of Technology is shown in Fig. 3.

The goals of the committee are to overview the state of the art in the pulsed power technology, and to get an outlook on the future directions of the technology at more than GW power level.

Reported by
Eiki Hotta (Tokyo Institute of Technology)
Douyan Wang (Kumamoto University)
Koichi Takaki (Iwate University)
Takashi Kikuchi (Nagaoka University of Technology)
Toru Sasaki, (Nagaoka University of Technology)
Kazuhiko Horioka (Tokyo Institute of Technology)

Electro-Magnetic Compatibility (EMC)

Chairperson: T. Funaki (Osaka University)
Vice Chairperson: K. Kawamata (Tohoku Gakuin University)
Secretaries: T. Ushio (Osaka University)
H. Sekiguchi (NMRI)
Assistant Secretaries: Y. Hayashi (Tohoku University)

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

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

1. Investigation committee on technical trends in evaluation of biological protection and compatibility with electromagnetic field.
2. Investigation committee on the analysis technology of electromagnetic filed including human body.
3. Investigation committee on the characteristics of noise accompanied with discharge.
4. Investigation committee on smart grid 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 technical report of investigation committee or to have special conferences, which are related to their research theme. The investigation committee on EMC technologies for Electro Static Discharge, which finished the research work and dissolved in March 2011 presented their research work as the journal paper in the special issue of IEEJ transaction on fundamentals and materials in (May 2012).

The Special Committee on Human Health Effect of
Electromagnetic Fields, which belongs to the head quarter of IEEJ, was dissolved on March 2012. Then, the function of responsibility and authority for research work of this special committee was transferred to this technical committee on EMC.

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, 22th(50th), November 21th(51th) for 2012, March 12th(52th), June 21th(53th) for 2013.

1. Investigation committee on smart grid and EMC.

This committee, chaired by Emer. Prof. M. Tokuda in Tokyo City University, was established in Apr. 2011. The mission of this committee is to sort out the international and domestic EMC problem related to smart grid, and to clarify the difference in the research and development of smart grid technology stemming from the difference in the regulation of EMC over the world. The committee is working on the following subjects.
1. Overall conditions of research and development of smart grid technology over the world;
2. Trend in the standardization of smart grid;
3. EMC regulations related to smart grid;
4. EMC problems in generation and transformation of electricity;
5. EMC problems in transmission and distribution of electricity;
6. EMC problems in communication network for smart grid;
7. EMC problems in load and energy storage.

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

2. Investigation committee on the characteristics of noise accompanied with discharge.

This committee, chaired by Prof. K. Kawamata of Tohoku Gakuin University, was established in Apr. 2011. The mission of this committee is to measure and figure out the characteristics of voltage and current response associated with ESD from the view point of EMC, and to clarify the mechanism in emission of electromagnetic field by ESD with associating the characteristics of electromagnetic field and parameters for discharge. The investigation subjects are summarized as followings.
1. Systemize the interfering object by ESD;
2. Basics and mechanisms of ESD;
3. Dominant factors and parameters of current waveform by ESD;
4. Measurement and prediction of transient waveforms by ESD;
5. Characteristics of electromagnetic field by ESD;
6. Optimization of ESD immunity test;
7. EMC modeling and simulation of ESD.

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

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

This committee, chaired by Dr. K. Yamazaki of Central Research Institute of Electric Power Industry, was established in Jul. 2013. The mission of this committee is to survey the current technical trends in numerical calculation and measurement evaluation of human exposure to electromagnetic fields. Moreover, this committee aims at accumulating the knowledge of this province by inquiring the standards and evaluation methods for electrical safety of human body, and by studying the applicability of numerical analysis of electrical magnetic field. The investigation subjects are summarized as followings.
1. Surveying the research trends for the evaluation of electrical quantities in human body with numerical analysis of electromagnetic field;
2. Surveying the trends in guidelines and standards for protection of human body to the exposure to electromagnetic field;
3. Surveying the standards and evaluation method for the indirect influence of electrical magnetic field on the human body protection and the human body safety with the facilities and instruments;
4. Find issues for future work.

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

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

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

1. Health effects due to exposure to extremely low frequency (50/60Hz) magnetic fields emitted from electrical power equipment and household electric appliances evaluated by epidemiology, human volunteer study, animal experiment, and cellular experiment;
2. Health effects due to exposure to intermediate frequency electromagnetic fields (300Hz – 10MHz) emitted from induction heating apparatus and wireless power transmission evaluated by epidemiology, human volunteer experiment, animal experiment, and cellular experiment;
3. Health effects due to exposure to radio frequency electrical magnetic fields in human;
4. Risk management and risk communication on electromagnetic fields;
5. Others.

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

Light Application and Visual Science (LAV)

Chairperson: Yoshiaki Tsunawaki (Osaka Sangyo University)
Secretaries: Mitsuhiro Kusaba (Osaka Sangyo University)

Activities of the technical committee on light application and visual science (TC-LAV) have been covering fields of visual/optical information processing and various kinds of application of optical engineering in the wavelength region from far-infrared (THz-wave) to extreme ultraviolet. In this report, two recent topics are introduced with respect to the formation of grating structure on a metal surface under the irradiation of femtosecond (fs) laser, and energy recycle using a base metal and solar pumped pulse laser.

The first topic is “Periodic grating structures on metal induced by fs laser pulses”. The grating structures are self-formed on metal surface with irradiation of linear polarized femtosecond laser pulses and they are oriented perpendicular to the laser polarization. To investigate the mechanism of self-formation, the grating structure interspaces dependence on laser fluence have been measured for Cu(1) and several metals (2). In the ranges of the laser fluence in which the grating structures are self-formed, the interspaces of the grating structures are shorter than the laser wavelength of 800 nm. The interspaces increase up to 680 nm as laser fluence increases. This dependence of the interspaces on laser fluence has been explained by the parametric decay model(3). However the model shows disagreement in the relatively low fluence range. This disagreement may be considered to arise from non-uniformity of ablation. Thus the formation of periodic structures is not yet fully understood(4). In this study, the relation between the ablation threshold and the formation threshold of periodic grating structures for metal is discussed.

In the experiments, short pulsed laser system ($\lambda = 800\ \text{nm}$, $\tau = 160\ \text{fs}$, 10 Hz) has been used. The laser beam is focused to a spot size of 45 $\mu m$ on the target surface with a lens ($f = 10\ \text{cm}$), at normal incidence in air. To avoid non-uniformity of intensity in the irradiated area on the surface, the laser intensity distribution is adjusted to be spatially uniform. The targets are Ti and Mo metals, which are mechanically polished. The roughness, Ra, is less than 2 nm for metals. The fluence is varied in the range of $F = 50$–2100 $\text{mJ/cm}^2$. The number of irradiating pulses is 50. Laser-produced surface structures are examined by scanning electron microscopy (JSM-5560, JEOL). The periodic grating interspace is determined by reading the peak value in the frequency domain after taking the Fourier transform for the 20 $\mu m \times 15\ \mu m$ area of the SEM image, which is equivalent to the laser irradiated area on the targets. The resolution of the present measurements of the periodic spacing is better than 34 nm. The dependence of the periodic structure interspaces on laser fluence for Ti and Mo metals is compared with the calculation results according to the parametric decay model (Fig.1), in which ablation threshold is taken into account. The model is in good agreement with the experimental results in the fluence range in which periodic grating structures are formed. These experimental results indicate that the formation
threshold of grating structure is closely related to ablation threshold.

The second topic is “Proposal of energy cycle using solar-pumped pulse lasers and base metal”. Recently, power generators using natural power sources, such as solar power, wind, heat, and biomass, have become more widespread due to the depletion of fossil fuels and safety problems concerning atomic power.

Our proposed energy cycle using solar-pumped pulse lasers and base metals is shown in Fig. 2. Solar light can be converted to coherent laser light. We develop solar-pumped lasers with high optical-optical conversion efficiency using Nd/Cr:YAG ceramics. Also, we investigate hydrogen production method using base metal nanoparticles, which are also applicable to metal air cells. Metal air cells generate electricity from the reaction of metal with oxygen. Metal oxides are produced after the base metals are used for power generation. The metal oxides in liquids are reduced using the solar-pumped pulse lasers. The apparatus is shown in Fig. 3. With this method, metal nanoparticles are produced in the reduction. Thus, chemical potential energy increases during the reducing process. This means that solar energy is stored in the metals efficiently. Used metals changed to metal oxides, and the metal oxides are reduced by laser pulse irradiation again. Our proposed air cells can be used as recyclable primary cells and can be used for transportation, such as for cars and bikes, small electrical devices, and as an electrical power source for homes. We conducted an experiment for charging Pb batteries of a small electric motorbike using electricity generated from air cells. The output power of the motor of the motorbike was 100 W. The small motorbike could run for around ten minutes after charging. We now discuss the electrical properties of the new metal air cells and their practical applications.

Air cells using metal plates with different species metal junctions were fabricated. Reduced metal nanoparticles from metal oxide powder by pulsed laser irradiation were used for making the metal paste.


References
(6) D. Graham-Rowe, Nature Photonics 4, 64 (2010).

Authors
Masaki Hashida (Institute for Chemical Research, Kyoto University)
Taku Saiki (Department of Electrical and Electronic Engineering, Kansai University)

Instrumentation and Measurement (IM)

Chairperson: Kazuo Tanabe (CRIEPI)
Vice-Chairpersons: Yoshitaka Sakimoto (JEMIC),
Akihito Otani (Anritsu)
Secretaries: Terumitsu Shirai (JEMIC),
Kazuaki Kodaira (JEMIC)

Annual activities
The Technical Committee of Instrumentation and Measurement (TC-IM) of IEEJ was set up in Jan. 1980, succeeding the Committee on Electronics Instrumentation and Measurement.

The technical committee of instrumentation and measurement hosts the following activities;
1) The general meeting of the committee is held four times per year for discussing the various activities of the committee. Fifteen members including the chairperson, two secretaries, and two assistant secretaries constitute the committee.
2) Workshops for the presentation and discussion of studies and researches take place almost every month in principle as a main activity of the committee.
3) Visits to various professional facilities are planned once or twice a year.
4) A special volume of the transaction of the society A (Fundamentals and Materials) in IEEJ is planned.
5) The investigating R&D Committee for Metrological Traceability related to Smart Grid (Jan. 2012 - Dec. 2014), which is the affiliate of the TC-IM, is active currently and the chairperson is Mr. Akio Iwasa who works for National Institute of Advanced Industrial Science and Technology.

Topics in workshops
The two contents, which were presented in the workshops in the preparatory stage, are roughly introduced in this article.

1) $C_0$ Cancellation of Crystal Resonator for QCM

Quartz crystal microbalances (QCMs), which can detect masses of nanograms or less, are used for measuring antigen responses, antibody reactions, and film thickness of evaporated thin films. A high frequency oscillation and expansion of the electrode’s area is important for improving detection sensitivity of a QCM. However, since degradation of an impedance of interelectrode capacitance ($C_0$) reduces excitation current, a quartz crystal cannot comport as an inductance. Therefore, we proposed a new tunable inductor using microstrip line (MSL) with a combination of a varactor diode for cancellation of $C_0$.

Fig. 1 shows a proposed circuit’s design of the MSL. This is designed for 3rd overtone frequency of a 155MHz AT-cut quartz crystal resonator. Fig. 2 shows a measurement result of resonators. In a resonator simple substance, it shows capacitive impedance in all

![Fig. 1 MSL with varactor diode for $C_0$ cancellation (Size: 40mm × 60mm).](image1)

![Fig. 2 Impedance characteristics of crystal resonator.](image2)
the portions of the range. On the other hand, in the proposal circuit, it shifted to inductivity from capacitive impedance like a usual crystal resonator. Table 1 is equivalent constant of crystal resonators shown in Fig. 2. Our method has improved $C_0$ to $1/40$ without degrading Q factor that represents the performance of a crystal resonator. Although it is difficult to obtain high-Q variable coil in ultra high frequency, our method is advantageous in order not to use a coil. Furthermore, this technology is applicable also to a MEMS resonator that has comparatively large capacitance, and the fabrication of a GHz band crystal oscillator.

This work was supported by grant-in-aid from Futaba Denshi Memorial Foundation, Japan.

Table 1. Equivalent constant of crystal resonator.

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<tr>
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<th>$R_1$ [$\Omega$]</th>
<th>$L_1$ [mH]</th>
<th>$C_1$ [$\Omega$]</th>
<th>$C_0$ [pF]</th>
<th>$Q$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Only crystal</td>
<td>60</td>
<td>0.44</td>
<td>0.25</td>
<td>3.8</td>
<td>$22 \times 10^3$</td>
</tr>
<tr>
<td>Crystal + MSL</td>
<td>64</td>
<td>0.47</td>
<td>0.24</td>
<td>0.08</td>
<td>$22 \times 10^3$</td>
</tr>
</tbody>
</table>

2) Experimental Manufacturing and Evaluation of a Novel Tunable Millimeter-wave Band Filter

Rapid progress in millimeter-wave wireless communication technologies requires accurate spectrum analysis in the frequency domain over 100 GHz. A tunable preselection filter is a key device in building such a spectrum analyzer. Therefore, we proposed a new tunable preselection filter in the frequency range from 110 to 140 GHz.

Fig. 3 shows a cross sectional view of the proposed filter. Two half-mirrors are constructed in a single, TE$_{10}$-mode rectangular waveguide. These half-mirrors compose a Fabry-Perot resonator. The resonator length $L$ is changed mechanically to choose a specific spectral element. Since only the TE$_{10}$ mode propagates in the waveguide, the propagation distance of the transmitted wave is uniquely defined and the phase of the electric field in the waveguide is adjusted without a special device to input a planar wave to the half-mirrors.

In order to validate the tuning function, we designed and fabricated a prototype. Fig. 4 shows an overview of the prototype. Fig. 5 shows the measurements and the theoretical center frequency $f_c$. The theoretical curve shifted to the left and matched the experiments, indicating the required filter tunability was achieved.

This work was carried out under the sponsorship of the R&D program for expansion of radio resources promoted by the Ministry of Internal Affairs and Communications, Japan.

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Table 1. Equivalent constant of crystal resonator.

<table>
<thead>
<tr>
<th></th>
<th>$R_1$ [$\Omega$]</th>
<th>$L_1$ [mH]</th>
<th>$C_1$ [$\Omega$]</th>
<th>$C_0$ [pF]</th>
<th>$Q$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Only crystal</td>
<td>60</td>
<td>0.44</td>
<td>0.25</td>
<td>3.8</td>
<td>$22 \times 10^3$</td>
</tr>
<tr>
<td>Crystal + MSL</td>
<td>64</td>
<td>0.47</td>
<td>0.24</td>
<td>0.08</td>
<td>$22 \times 10^3$</td>
</tr>
</tbody>
</table>

Fig. 3. Cross sectional view of waveguide (E-plane)

![Fig. 3. Cross sectional view of waveguide (E-plane)](image)

Fig. 4. Overview of prototype

![Fig. 4. Overview of prototype](image)

Fig. 5. Measurements of center frequency $f_c$

![Fig. 5. Measurements of center frequency $f_c$](image)

References


WEB site and authors

Activity of our committee is also described in our website (http://www2.iee.or.jp/~aim/).

Written by Dr. K. Tanabe (Chairperson, CRIEPI, e-mail: tanabe@criepi.denken.or.jp), T. Imaike (Nihon University), T. Kawamura (Anritsu).
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, electro-chemical affinity, radio-activity, 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 resent Symposiums 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 three or 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.

Table 1  Symposiums in the National Convention of the IEEJ

<table>
<thead>
<tr>
<th>Theme</th>
<th>Date</th>
<th>Site</th>
</tr>
</thead>
<tbody>
<tr>
<td>Development and problem of the high-efficiency solar cell</td>
<td>2009.03.19</td>
<td>Hokkaido University</td>
</tr>
<tr>
<td>Metal and ceramic materials in energy strange systems</td>
<td>2010.03.19</td>
<td>Meiji University</td>
</tr>
<tr>
<td>The 100th anniversary symposium for superconductivity discovery</td>
<td>2011.12.12</td>
<td>IEEJ meeting room</td>
</tr>
<tr>
<td>The latest research and development trend about thermo-electric material and its application</td>
<td>2013.3.19</td>
<td>Nagoya University</td>
</tr>
</tbody>
</table>
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 “Low temperature electronics based on phase engineering”. The chairperson is Prof. Akira Fujimaki (University of Nagoya) and secretaries are Dr. Masamitsu Tanaka (University of Nagoya) and Dr. Yuki Yamanashi (Yokohama national university). Regularly, there are four meetings a year.

This committee conducts investigation about the low-temperature electronics based on the phase engineering which is an ultramodern field. The possibility and the suitable applicable fields of development of the phase engineering are clarified from the results of an investigation.

This investigating committee performs investigation and examination of the following topics.
1) A new technology based on magnetic superconductive material, superconductor junctions and its possibility of the application to superconducting digital electronics devices are investigated.
2) The recent research trends of magnetic-hybrid devices, including spin injection devices, are investigated.
3) The recent research trends of superconductive circuits based on the precise phase control are investigated.
4) The possible application fields of the phase engineering technology toward such as the detectors and counting systems are investigated.
5) The possible application of the phase engineering technology toward the quantum-information-processing is investigated.

The previous committee has a plan of the study meeting related with the advanced superconducting materials (IV) on November 2013. This meeting will be held to exchange information between young researchers belonging to several communities. Therefore, the new style of the presentation is adopted, which is combination of a short presentation and a poster session.

Table 2  Study Meetings in TC-MC

<table>
<thead>
<tr>
<th>Theme</th>
<th>Date</th>
<th>Site</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recent research progress in advanced superconducting materials (II)</td>
<td>2011.10.23</td>
<td>University of Tokyo</td>
</tr>
<tr>
<td>Recent research progress in advanced superconducting materials (III)</td>
<td>2012.12.16</td>
<td>University of Tokyo</td>
</tr>
<tr>
<td>Recent research progress in advanced superconducting materials (IV)</td>
<td>2013.11.17</td>
<td>University of Tokyo</td>
</tr>
</tbody>
</table>

Table 3  Investigation Committee under the TC-MC

<table>
<thead>
<tr>
<th>Research Subject</th>
<th>Chairperson (Affiliation)</th>
<th>Period</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low temperature electronics based on phase engineering</td>
<td>Prof. Akira Fujimaki (University of Nagoya)</td>
<td>2013.10-2016.09</td>
<td>Open</td>
</tr>
</tbody>
</table>

Technical Committee on Electrical Wire and Cables (EWC)

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

Technical Committee on Electrical Wire and Cables (TC-EWC) is a committee organized in the IEEJ Power and Energy Society, and is comprised of members from cable manufacturers, power utilities, railway companies, universities and related research institutes such as Japan Electric Cable Technology Center (JECTEC) and Central Research Institute of Electric Power Industry (CRIEPI). The technical committee organizes technical meetings to promote R&D activities in this field and provides an opportunity to present technical achievements. Two technical meetings were so far held in 2013, one of which was on degradation diagnosis and asset management of wires, cables and power apparatuses and was held as a joint meeting with TC-DEI. The other was on technology for long-distance high-capacity power transmission. The technical committee also held a forum on recent technological trends in overseas power transmission cables. The technical committee plans to organize 3 more technical meetings, a forum and a symposium in FY2013. Two of the planned technical meetings will be jointly held with TC-DEI. The forum will be on the trends and status quo of diagnosis and assessment technologies for distribution wire and cables, and the symposium will be on recycling technology for wire
and cables.

In addition to organizing such meetings, forums and symposia, the technical committee supervises investigation committees dealing with subjects related to electrical wire and cables. During the last several years, investigation committees were organized on the following subjects, i.e. technology of wires and associated accessories for overhead transmission lines, accessories for 66kV and higher voltage XLPE power cables, technology of XLPE power cables and associated accessories for underground power distribution, technical trend of environmental tests for insulation materials of distribution wires and cables, and recent technological trends in overseas power transmission cables. The technical report of the last committee was published in December, 2012. The Investigation Committee for Technical Trend of Recycling Technology for Wires and Power Cables is now in action and the Investigation Committee for Technical Trends in Overhead Transmission Cables and Their Accessories will be launched in October, 2013.
IEC TC15 Japanese National Committee

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

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

IEC TC15 establishes definitions, general requirements and specification sheets for individual types of materials. The standards include test methods and guidance where these are required for the specifications. The current activities of TC15 are carried out by 5 working groups (WGs) and 4 maintenance teams (MTs). IEC TC15 has now more than 160 standards published, and 15 work programs for standardization are in progress.

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

To accomplish the tasks of the WGs and MTs in TC15, the experts from Japan participate in MT 3 (plastic films), WG5 (flexible insulating sleeving), and WG 9 (cellulosic materials). They are contributing to accomplish the new work item and revisions of the present standards. Especially in MT3, which deals with plastic films for electrical insulation, IEC 60674-2 (Methods of test) is now going to be revised by the lead of Japanese convener. In WG 9, specifications of an insulating cellulose paper for coil winding are also proposed to include to Part 3 sheet of IEC 60554 from Japan in order to offer the appropriate and useful standards for the market.

IEC TC15 international meeting has been annually held. The meeting of this year was held on May in Kista, Sweden (Fig.1). 5 members from Japan participated in MT 3 and WG 9 meetings and 3 members in the plenary meeting. A draft for the revision of IEC 60674-2 was discussed in MT3, and it was decided that CD will be circulated within this year. In WG 9, an addition of the new type of insulating paper is considered with a plan for consolidation of part 3 sheets of IEC 60554.

Fig.1 Social event after plenary in Kista 2013