ACTIVITIES OF THE TECHNICAL COMMITTEE ON DEI IN IEEJ

Digest Reports of Investigation Committees in DEI

Investigation Committee on Assessment and Improvement of the Interface in Composite Electrical Insulation

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1. Purpose of the committee

Interface is a new challenging area of investigation. This area has emerged, because of the recent requirement for extremely compact design of insulation and simple installation for its application. The purpose of Investigation Committee on Assessment and Improvement of the Interface in Composite Electrical Insulation is to survey and discuss the influence of interfaces on the electrical insulating properties of composite electrical insulating systems. The committee is composed of WG1 (interfacial problem in XLPE cable joint) and WG2 (polymer composite insulator). In both WGs, round robin tests are being carried out in collaboration with CIGRE WG15-10 and WG 15-04.

2. Activities

The committee was established in January, 1999. Until now 28 times of meetings had been held including general meetings, WGs 1 and 2 and executive meetings. The discussions were mostly based on the results of cooperative tests. In addition, research information in this field was acquired and exchanged. The activity was corresponded to the domestic committee of CIGRE SC-15, and the information was distributed to the concerning WGs of CIGRE international committee. The items being investigated by each working group are as follows.

WG1:

- (1) Survey and comparison of features of electrode systems modeling the interface in XLPE cable joints and terminations.
- (2) Cooperation to International Round Robin Test for assessing interfacial electrical insulation properties in cable splices.
- (3) Manualization of the assembling procedure of model electrode systems.

(4) Survey of papers in- and outside Japan on interfacial electrical insulation properties and their assessment.

WG2:

- (1) Conducting the Round Robin Test of Salt Fog Chamber Method according to CIGRE WG-15.04 recommendation.
- (2) Development of standard measuring system of surface discharge and leakage currents for outdoor insulation assessment.
- (3) Survey and comparison of features of accelerated aging tests for polymer composite insulators
- (4) Hydrophobicity of polymer materials and fundamental phenomena of discharges.

3. Technical report of IEEJ

The committee is now summarizing technical report of IEEJ. The report will be divided into two parts.

Part 1 (WG1) deals with the survey of cable joints which are being developed and applied. It also describes the testing methods for the assessment of internal interfaces. Especially, assembly, testing condition and experimental result of testing electrodes are described in detail. The features of electrodes are then compared. Moreover, fundamental phenomena in respect to internal interface are reviewed.

Part 2 (WG2) deals with the salt fog test for polymer materials (mostly silicone rubbers) based on the round robin test. Testing conditions, discharge measurement, and validity of data and methodology as well as the possibility of new testing methods are summarized.

As for aging of the materials, discharges are categorized into three kinds to discuss their effect on the materials. In addition, relation between lab acceleration test and field aging is discussed.

Investigation Committee on Various Problems with High Reliability for Insulation of Electronic Equipment

T.Tsukui (Tokai University), Y.Yamano (Chiba University)

K.Shutoh (Science University of Tokyo),

S.Yoda (Hioki Electric Co. Ltd.)

Electronic equipment is becoming small in size, light in weight, and high in performance. The printed wiring boards for the equipment are designed in fine and high density with multi layer, which result in small distance and high electric field strength between the foil conductors on the board. The insulating failures may occur on the board under such conditions. Therefore, an insulating reliability comes up to an important problem for the design of electronic equipment and systems. However, the study on the insulating reliability for the printed wiring board has not been systematically carried out.

One of the reasons for this may be a low operating voltage in the electronic circuit. Furthermore, it is impossible to evaluate the reliability of the board by long term testing, because the electronic products such as personal computer or portable telephone must be designed within short-range term by request of a market.

In the previous investigation committee with the insulation reliability of the printed wiring board, the round robin tests of the ionic migration were carried out by more than 10 members to establish the evaluation method for the reliability by the environmental aging test. However, the tests under various environmental conditions have not been carried out yet.

From these viewpoints, a new investigation committee has started in April 1999 with 27 members.

The main subjects of the committee are as follows.

- (1) Survey on test methods for insulating failures due to the ionic migration.
- (2) Survey on the insulating reliability with multiconstructed printed board.
- (3) Survey on insulating strength between the conductors against surge of high voltage.

We have held 15 committee meetings and 3 study meetings since the start of the committee. From last year, we have started the round robin test with the surge endurance of the printed wiring board. In the round robin test, the surge endurance in air is studied for the printed wiring board on which the distance between the foil conductors ranges from 30 m to 500 m. The influence of the surge endurance upon long-term exposure of high humidity and contaminated gas is investigated by some of the members. Furthermore, the endurance test is performed for the board with surface coating.

Now, we are discussing the experimental results obtained from the committee members. Also, we are surveying on practical problems with the insulating reliability occurring in the product of electronics equipments and products. We have started to edit the technical report based on the results of the round robin test and the surveys, which will be published at the end of the committee.

Investigation Committee on Insulation Lifetime of Dielectric Materials and Electrical Apparatus

T.Ito (Musashi Institute of Technology) M.Miyamoto (Fuji Electric Corporate Research and Development, Ltd) K.Uchida (Chubu Electric Power Co., Inc.) Y.Ehara (Musashi Institute of Technology) K.Segawa (Toshiba Corporation)

The committee was established in April 1999 with the term of three years. The committee consisted of 30 members from universities, research institutes, electric power companies, power apparatus manufactures and user companies. The diagnosis of insulating performance in power apparatus is an important research area to estimate the lifetime of electric apparatus, power cable and several electric installations. There are unknown deterioration mechanism still to be investigated on the insulating material and several electric apparatus. The following activities have been achieved by this committee;

(1) Investigation on relation between the deterioration mechanism of insulation material such as partial

discharge, treeing and other signals for the deterioration.

- (2) Investigation on the diagnosis for power apparatus and power cable prior to breakdown.
- (3) Investigation on the prediction of life limitation with rotating machine, cable, transformer, capacitor and power system.

The committee has held 5 meetings in 1999, 7 meetings in 2000 and 5meetings in 2001 respectively. In 1999, the committee promotes the Asian Conference on Electrical Insulation Diagnosis (ACEID), and sent 17 papers from Japan. In 2001 International Symposium on Electrical Insulating Materials (ISEIM), committee jointly promotes ACEID with ISEIM, consequently many papers will be present from China and Korea. The committee will be promoted the study meeting with insulation lifetime and diagnosis of

Investigating Committee on Development of Dielectric and Electrical Insulation Technology to Organic Molecular Device Engineering

Mitsumasa Iwamoto (Tokyo Institute of Technology), Mitsuyoshi Onoda (HimejiInstitute of Technology), and Akihiko Sugimura (Osaka Sangyo University)

Abstract

The committee started in January 2000 by 21 members to investigate and discuss on the interfacial electronic phenomena and functional properties of organic thin films and will be continued until December 2002. We have held 10 committee meetings and 10 secretary meetings up to August 2001. The main investigation subjects in the meetings are as follows.

- (1) Trends and topics on the nanometric interfacial controlled molecular device.
- (2) Control and electronically and optical functions on charge transfer at the nanometric molecularinterfaces and trends and topics on their evaluation technique.
- (4) Relationship between electronic states and injection mechanism at the nano-metric molecular-interfaces and topics on the injection type organic devices.
- (4) Trends and topics on the molecular dynamics and modification of organic materials.
- (5) Trends and topic on the interfacial phenomena the dielectric and electrical insulation technology.
- (6) Trends and topics on the fabrication of the organic molecular devices and their application to information systems.
- (7) Other trends and topics concerning the interfacial phenomena for organic materials.

This committee is actively in action under various planning such as the enforcement of the international conference and the publication of the special issue, etc. The results of investigation and survey will be published in Technical Report of IEEJ.

Purpose of establishment and activity

As organic materials have excellent insulating and dielectric abilities, they play an important role as covering and insulating materials for power and communication cables and other electrical equipment. However, recently the techniques of constructing highly-ordered and super-structured organic films have developed rapidly and its achievements and also essential electronically and optically functionality of organic materials have become a center of attraction. In order to utilize their functions sufficiently, the understanding on the electronic phenomena and electronic energy states on the order of nanometer scale at the molecular films/electrode interface and between auite different molecular films interface is indispensable. It seems to be the most probable that highly-ordered organic thin films will be put to practical use as an

intellectual films with learning effects, etc. from the completely new viewpoints in the electrical and electronic fields.

In the present situation, we are under investigation mainly that what the electronic and optical properties at the interface of highly-controlled organic thin films were clarified by what kind of techniques so far, what types of their intellectual functionality were studied so far from the viewpoints of the electronic and optical properties and then what are the subjects of this matter for a future study, etc. That is,

- (1) Trends and topics on the nanometric interfacial controlled molecular device.
- (2) Control and electronically and optical functions on charge transfer at the nanometric molecularinterfaces and trends and topics on their evaluation technique.
- (3) Relationship between electronic states and injection mechanism at the nanometric molecular- interfaces and topics on the injection type organic devices.
- (4) Trends and topics on the molecular dynamics and modification of organic materials.
- (5) Trends and topic on the interfacial phenomena in the dielectric and electrical insulation technology.
- (6) Trends and topics on the fabrication of the organic molecular devices and their application to information systems.
- (7) Other trends and topics concerning the interfacial phenomena for organic materials.

Since the establishment of this committee, the study meeting was held 10 times up to August 2001. Furthermore, the special issue entitled "Present Status and Future Scope of Organic Molecular and Material Electronics" has been published in the Transaction of IEEJ, part A in 2001, July, and The 1st International Discussion & Conference on Nano-Interface Electronic Devices had been held at KyongJu, Korea on July 16-20, 2001 (The papers presented there will be published in a special issue of Journal of Korean Institute of Electrical Engineers), and the annual meeting on dielectrics and electrical insulation ,IEEJ entitled "Organic Thin Films" has been planned in this committee and held in October, 2001. And also in April 20, 2001, this committee gave a course in trends and topics on the electrical and optical functionality and evaluating technique for highly-controlled organic alignment films sponsored by Tokyo chapter, IEEJ. The three years activity of the committee will be published in Technical Report of IEEJ.

Investigation Committee on Future Prospect of the Research and Development of Electrical and Electronics Insulation and its Systems

Toshikatsu Tanaka (Waseda University and CRIEPI) Kazutoshi Goto (Consultant) Masayuki Nagao (Toyohashi University of Technology) Hiroyuki Nishikawa (Shibaura Institute of Technology)

Electrical insulation has been regarded as a matured technology. Since the demand for electricity in Japan is expected to grow one or two percent per year in the next half of the century, the present technologies remain good enough to respond to the future demands for the next 50 years. There may be even a concern about the progress of the electrical insulation technology.

On the other hand, there have been social changes such as concerns to the global environments and deregulations in the power industry, which may lead to the future innovation in the power industry. In response to these issues, proposal of alternative technologies including both hardware and software have been made, such as Power Former, Dry Former, DC Microgrids, and demand side power networks. In view of these emerging technologies, the present committee will address to the issues on the future prospect of the research and development of electrical and electronic insulation and its systems.

In the area of insulation technologies for electronics and microelectronics, rapid progress has been made to realize the miniaturization and advanced functions of these devices. Such progress leads to the situation where the required properties of the materials such as breakdown strength and dielectric constants almost reached to the intrinsic values of the materials. For example, alternative high-k dielectrics for MOS gate and low-k dielectrics for the inter-level dielectric layers have been intensively studied for further downsizing of LSI.

With this background, the present investigation committee started activities in April 2000, focusing on the future prospect of the research and development of electrical and electronic insulation and its system. In this committee, nearly matured technologies in electronics insulation and emerging technologies in electronics insulation are reviewed for future prospect of their R&D. Electrical insulation should be matched with social and technological requirements such as environmental protection, transition from component technologies and system technologies, and downsizing and low cost. Electronics insulation faces with extreme downsizing and needs counter measures against insulation degradation under the high electric stress. The Electricity Technology Roadmap has been investigated and issued by EPRI (USA). Also, a governmental committee has been formed to pursue a roadmap for electric power technology.

In our present committee, future prospect of the electrical insulation technologies will be discussed in connection with the activities of these committees.

We focus on the analyses of the following points:

- (1) The changes in the social and technological requirements to the new electrical and electronic insulation and its systems.
- (2) Achievements and future prospects of apparatus and cables
- (3) Achievements and future prospects of electronic and microelectronic devices
- (5) Achievements and future prospects of basic phenomena in electrical insulation
- (6) Achievements and future prospects of testing, monitoring, and maintenance of electrical insulating materials.

From these activities, we will present the future prospect of the research and development of electrical and electronic insulation and its systems, thereby giving an impact on the activities in education, research and development in the related area.

Since established, both formal and informal meetings including five committee meetings and a symposium session, have been organized by the present committee until now. A draft of Technical Report of IEEJ will be issued on the basis of the two-year activity of this committee by the end of March 2002.

In conclusion, nearly matured technologies in electrical insulation and emerging technologies in electronics insulation has been intensively explored for future prospect of their R&D. Electrical insulation should be matched with social and technological requirements such as environmental protection, transition from component technologies to system technologies, and downsizing and low cost. Electronics insulation faces with extreme downsizing and needs countermeasures against degradation under the high electric stress

Investigation Committee on Functions of Organic Molecular Films and Organic/Inorganic Composites

Futao Kaneko (Niigata University) Yasuo Suzuoki (Nagoya University) Keizo Kato (Niigata University) Kazunari Shinbo (Niigata University)

The committee was established in July 2000, with the term of three years. The investigation has focused attention on the functions of organic molecular films and organic/inorganic composites related to:

- 1. fabrication techniques and functions of molecular ultrathin films and organic thin films,
- 2. functions of organic/inorganic composites,
- 3. evaluations of organic/inorganic ultrathin films, and
- 4. optical and electrical properties of ultrathin film interfaces and device applications.

Up to September 2001, seven committee meetings were held and three meetings of them were held for visiting distinguished laboratories in Japan, that is, Chiba Univ., Nagoya Univ., Tokyo Institute of Tech. Lectures were given by the researchers at the labs about hybrid organic electroluminescent transistors, evaluation of organic thin film structure using photoelectron spectroscopy, fabrication and optical properties of organic/inorganic hybrid materials, fabrication and passivation of organic light emitting diodes, liner and non-liner optics of surface plasmon sensor, dynamic control of polymer film using light irradiation, and so on. Observations of their research laboratories were also carried out after their lectures. Furthermore, detailed discussions among the members of the committee were also carried out for their researches. There have been further lectures by the member and non-member researchers.

The results of the investigation will be summarized at the end of the term in 2003 as a technical report. Investigations for fabrications and evaluations of organic thin films and organic/inorganic composites are very useful for new functional devices in the future.

Investigation Committee on Advanced Measurement Methods on Partial Discharges in Electrical Apparatus

Ken Kimura and Masayuki Hikita (Kyushu Institute of Technology) Naohiro Hozumi (Toyohashi University of Technology) Naoshi Hirai (Waseda University)

According to deregulation policies all over the world, electric utilities have to compete each other and against independent power producers (IPP) in price and quality of electricity. For cost reduction of power generation, availability of facilities in power stations (PS) should be improved using advanced technology. One of the approaches is so called condition-based maintenance (CBM) with multiple on-line monitors.

In the case of rotating machines too, on-line partial discharge (PD) monitors have been intensively developed and commercially available at present. Generally, newly developed monitors tend to adopt higher frequency in detecting circuits to avoid the noise in lower frequency regions. On the other hand, rotating machines have large inductance and capacitance along windings, which cause the deformation of original wave form of PD pulse during propagation from PD source to detecting couplers. So more discussions and cautions are necessary for practical application of the

monitors as CBM tools.

Recently IEEE Power Engineering Society has issued a new guide : IEEE Std 1434 -2000 "IEEE Trial-Use Guide to the Measurement of Partial Discharges in Rotating Machinery". The standard involves important and beneficial information especially for maintenance engineers.

Dielectric and Electrical Insulation Technical Committee, IEE Japan has also strong concerns on online PD measurements of rotating machines with above-mentioned reasons and started a new investigation committee. The new committee started January 16th, 2001 with 20 members from electric power utilities, universities and manufactures. Based upon the bibliography of IEEE Std 1434, original papers on PD monitoring including Japanese papers are investigated in detail. Final Technical Report will be issued from IEE Japan in 2003.

Cooperative Research Committee on EINA Magazine

Chairperson	T. Tanaka (Waseda University and CRIEPI)
Secretary	Y. Inoue (Toshiba Corporation)
Secretary	Y. Maruyama (Furukawa Electric Co. Ltd.)

HISTRY OF COMMITTEE

Preceding committee (Cooperative Research Committee (CRC) of Asian Interlink on Dielectrics and Electrical Insulation) worked from Jan. 1991 to Dec. 1992. The committee reviewed the present status of scientific and technical cooperation in the field of

dielectrics and electrical insulation among Japan and Asian countries and sought the appropriate ways to promote it.

As an important activity discussed in the committee, "CRC of Electrical Insulation News in Asia" (the chairman of the committee was Prof. H. Yamashita, Keio Univ.) was established in Apr. 1994 and edited and published "Electrical Insulation News in Asia (EINA)" No. 1 (Sept. 1994), and No. 2 (Sept. 1995). As the EINA magazine was hoped to continue to be published, Prof. Yamashita chaired the CRC from 1994 to 1999 and published EINA magazines to No. 6.

In 2000, Dr. T. Tanaka succeeded to the activity and established a new CRC of EINA Magazine".

ACTIVITY OF COMMITTEE

The present committee has a Chairman, two secretaries and 26 members. It has a general meeting and two or three secretary meetings a year and discusses the activity and contents for the next edition of the EINA.

We had a meeting to discuss academic and technological information exchange on Electrical Insulation in Asia on the occasion of International Conference on Properties and Application of Dielectric Materials (ICPADM 2000) held in Xian Jiaotong University, China. In the meeting, the expectation of information exchange through internet WEB and mutual information exchange, which agreed with chairman's idea, was presented.

The committee published EINA No.7 in November, 2000 and opened an EINA WEB SITE (http://boss.eee.tut.ac.jp/eina/) in March, 2001.

The committee will publish EINA No.8 (this EINA) in November, 2001 and enrich the content of the WEB page.

MAIN SUBJECTS OF EINA

Main subjects of EINA are as follows:

- Preface
- Outline of technical committees on Dielectric and Electric Insulation (DEI) and related TCs in IEEJ
- Activities of the Technical Committee on DEI
- · Technologies for Tomorrow
- Technical Exchanges between Asian Countries
- Records and announcements of international conferences in Asia
- Introduction of laboratories in Asia
- · Letters from readers
- Front and rear covers show color photos of the state of the art industrial products or experimental facilities and fundamental research achievements

The committee expects your contributions to the EINA Magazine and the WEB page.





IEEJ Technical Reports Edited by TC-DEI and Related TCs

Technical reports listed here are made by investigation committees in the technical committee on DEI and related investigation committees since the publication of EINA No. 7 (2000). They are described in Japanese.

No. 810 :	"Application of discharge plasma to reform of environment	r", (A), p.62, Nov., 2000, ¥3,500
No. 817 :	"Toward advanced chemical sensor — Active chemical sen	usor—", (E), p.30, Feb., 2001, ¥2,400
No. 824 :	"Evaluation and control of structure and performance of molecular ultra thin film and organic thin film — application to devices and new development—", (A), p.62, June, 2001 ¥2,400	
No. 830 :	"Plasma display discharge and efficiency of luminescence"	, (A), p.86, May, 2001, ¥3,100
No. 834:	Measuring method of space charge distribution and standardization", (A), p.74, Apr., 2001, ¥2,400	
No. 836:	"Electromagnetic phenomena due to earthquake",	(B), p.66, May, 2001, ¥2,300.
No. 840:	"Traceability of high voltage measurements",	(B), p.32, July, 2001, ¥1,900.
No. 841:	"Earth environmental load of SF ₆ and SF ₆ merged gas insulation and substitution gas insulation", (A), p.62, May, 2001, ¥2,300	

N. B. : (A - E) after titles mean a Society in which Technical Committees work :

- A: Fundamentals and Materials, in which the TC-DEI is included
- B: Power and Energy
- C: Electronics, Information and System
- D: Industry Applications
- E: Sensors

¥ : Japanese Yen

By Mr. Yoshio Maruyama (Furukawa Electric Co., Ltd.)