STRIKING MESSAGE FROM VI PROFESSORS

In Retrospect

Masamitsu Kosaki

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

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

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

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

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

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

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

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

Bridge between Science and Technology in the Electrical Insulation Field

Teruyoshi Mizutani

Emeritus Professor of Nagoya University

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

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

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

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

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

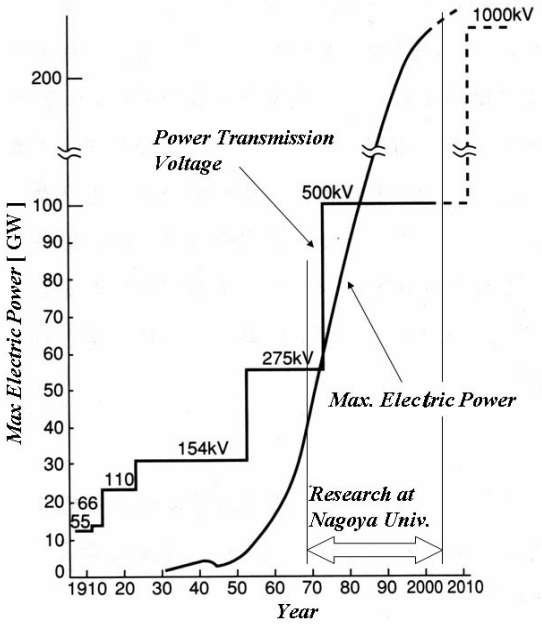

Fig. 1: Period of my research on electrical insulation at Nagoya Univ.

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

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

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

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Initiation of ICPADM and Internet Age

Tatsuo Takada

Emeritus Professor of Musashi Institute of Technology

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

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

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

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

The age of Internet based on submarine cable system

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

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

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

Utilization of the Internet for international collaborative research

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