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FOREIGN TRIP REPORT

ORNL/FTR-3772

DATE: October 5, 1990

SUBJECT: Report of Foreign Travel of L. G. Christophorou, Group Leader, Atomic, Molecular, and High Voltage Physics Group, Health and Safety Research Division.

TO: Alvin W. Trivelpiece

FROM: L. G. Christophorou

Attend 10th International Conference on Conduction and Breakdown in Dielectric Liquids.

SITES

VISITED: 9/10-14/90 Laboratoire d' Electrostatique et de R. Tobazeon
Materiaux Dielectriques, Grenoble, France

ABSTRACT: The traveler attended the 10th International Conference on Conduction and Breakdown in Dielectric Liquids held in Grenoble, France, September 10-14, 1990. He chaired the opening session of the conference, presented one paper, co-authored a second paper presented at the meeting, participated in the discussions during the formal sessions, and had informal discussions with many of the participants.

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**PARTICIPATION AT THE 10TH INTERNATIONAL CONFERENCE
ON CONDUCTION AND BREAKDOWN IN DIELECTRIC LIQUIDS;
VISIT TO LABORATORIES OF ELECTROSTATICS AND DIELECTRIC MATERIALS
GRENOBLE, FRANCE
SEPTEMBER 10-14, 1990**

The traveler attended the 10th International Conference on Conduction and Breakdown in Dielectric Liquids which was held at Grenoble, France, from September 10 to September 14, 1990. He chaired the opening session of the conference, presented one paper, co-authored a second paper presented at the meeting, participated in the discussions during the formal sessions, and had informal discussions with many of the participants. The traveler also visited the Laboratories of Electrostatics and Dielectric Materials of CNRS at Grenoble, France.

The conference was very successful. It was multidisciplinary in nature. It allowed a rather intense discussion among the participants during the entire meeting and also after the many excellent papers were presented. It was attended by about 130 scientists and engineers from 20 countries. A rather large and aggressive Russian delegation was present with a clear plan to project their work. The United States was represented by eight scientists.

A rather nice feature of the conference format was the "introductory" lectures, i.e., 40-minute talks on the session subject which were tailored to the papers presented at the session. This clearly helped the audience by providing an appropriate frame for the reports that followed. Another nice feature was the "one-minute-per-paper" session, where the author of each poster paper was given one minute to summarize his paper. This helped draw large numbers of participants to the poster sessions.

The conference covered a large range of subjects dealing with electrons in liquids; conduction, irradiation, and electron-injection phenomena; liquid structure; bubbles and prebreakdown phenomena and their role in liquid breakdown; streamers and discharges in liquids; liquid-ionization chambers; liquid purification procedures, techniques and applications. On the engineering side, a number of topics dealt with polymers, transformer oils, and the effects of water and electronegative gases on the dielectric strength of liquids.

It can perhaps be stated that this has been the conference where clearly the role of the gas in the liquid has been fully accepted and documented. The traveler had argued earlier that gaseous processes play a crucial role in triggering prebreakdown events in electrically-stressed liquids. In this conference, the conference of the "gas bubbles," gas-phase prebreakdown and breakdown processes and knowledge have been invoked to explain the same phenomena in liquids. One can say that at least for certain cases, a gas phase is embedded in the liquid and crucially affects the electrical behavior of the liquid.

Thus, physical quantities such as the ionization coefficient, attachment coefficient, and drift velocity and concepts such as the Townsend avalanche, streamer formation, and even streamer-to-leader transition have been implicated for understanding the electrical properties of liquids. The traveler cautioned, however, that such quantities are normally different in the liquid compared to the gas, and extreme care is required when gas-phase knowledge is used to interpret liquid-phase phenomena. The USSR scientists seem to be rushing ahead to take the lead in using gas-phase physics and processes to understand the electrical properties of liquids. They are mostly interested in the energetics of electrons in polar, nonpolar, and cryogenic liquids. They maintain that in all these liquids the mechanism of breakdown initiation proceeds by electron multiplication--just as in gases--except that in liquids the process is initiated by microbubbles. They, as well as others, reported on calculations of electron energies in liquids, electron drift velocities in liquids, and ionization coefficients in liquids.

Among the other basic topics covered at the conference which are of interest to the traveler and directly relevant to his work at the Oak Ridge National Laboratory (ORNL) are: photoionization of molecules in supercritical fluids; electron transmission in liquid-vapor interfaces; photoinjection into liquids, especially fast room temperature liquids and cryogenics; calculation of the effective electron mass m^* and conduction band energy V_0 for excess electrons in dense rare gases as a function of density; electron thermalization in fluids; geminate recombination; ionization yields; and liquids for radiation detectors.

The traveler had extensive discussions with many of the participants, especially on liquids for possible use in the Super Conducting Super Collider detectors. Certainly there still seems to be no clear choice of liquid although the liquid tetramethylsilane seems to be the most promising, as we reported earlier. Others are advocating studies of heavy metal hexafluorides. The possible use of CH_4 liquid as a fast medium for neutron detectors was also discussed. Among the participants the traveler had scientific discussions with are:

R. Tobazeon (CNRS, Grenoble, France)
 E. Förster (Rutgers University, USA)
 T. J. Gallagher (University College, Dublin, Ireland)
 R. Hebner (NIST, USA)
 W. F. Schmidt (Hahn-Meitner Institute, Berlin, Germany)
 K. Yoshino (Osaka University, Japan)
 R. K. Watson (Xerox Corporation, USA)
 R. C. Munoz (CERN, Switzerland)
 A. Denat (CNRS, Grenoble, France)
 M. Goldman (Ecole Sup. d' Electricite, France)
 I. Lopes (University of Coimbra, Portugal)

Our work at ORNL was received enthusiastically at the conference. Our gaseous, interphase, and liquid phase work is having a rather profound impact on many studies dealing with basic aspects of the electrical properties of liquids, especially now that it is recognized that gaseous processes underpin many basic processes in liquids which determine their electrical behavior.

A number of new ideas emerged from these discussions which will be investigated at the traveler's laboratory. A number of reprints and preprints along with the conference proceedings have been acquired and will be circulated among the staff.

In general, Europe is focusing on the liquid state of matter rather aggressively. They attract young scientists to the field, have well equipped laboratories (as the ones the traveler visited at the CNRS in Grenoble), and seem to be allocating resources to this area. By contrast, we in the USA--in spite of repeated urging by the traveler and others--seem to be slow and indecisive.

ACKNOWLEDGEMENT

The traveler wishes to thank the laboratory and the Department of Energy (DOE) for their support which made this most successful trip possible.

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- 9/8-9 Travel from Oak Ridge, Tennessee, to Grenoble, France
- 9/9-14 Conference, Laboratoire d' Electrostatique et de Materiaux Dielectriques, Grenoble, France
- 9/14-16 Travel from Grenoble, France, to Oak Ridge, Tennessee

PERSONS CONTACTEDNameInstitution

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