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Proceedings

Seventh
International Conference on
Conduction and Breakdown in
Dielectric Liquids
Berlin - West - Germany
27. July - 31. July 1981

edited by

Werner F. Schmidt
Berlin

Sponsored by the
IEEE Electrical Insulation Society

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7. ICDL
BERLIN

PREFACE

This book contains the papers submitted to the "7.International Conference on Conduction and Breakdown in Dielectric Liquids", Berlin-West-Germany, July 27. to 31., 1981.

This series of conferences provides an interdisciplinary forum for the exchange of ideas and information on dielectric liquids. It addresses itself to materials scientists, physicists, chemists, and electrical engineers, who are engaged in fundamental and applied work on liquid dielectrics. The topics of the papers presented for the 7.ICDL range from fundamental studies on generation, transport and properties of charge carriers, conduction mechanisms to problems encountered in the application of insulating oils in electrical equipment. Some contributions from adjacent fields which relate directly to the main theme are also included.

The planning of this conference began in 1978 immediately after the Rouen meeting (6.ICDL) and it was the joint effort of the International Advisory Committee and the Local Committee. The 7. ICDL acknowledges agratefully financial support obtained from the following organizations and agencies

Deutsche Forschungsgemeinschaft,Bonn
Exxon Research and Engineering Co., Linden,N.Jersey
Hahn-Meitner-Institut für Kernforschung, Berlin
IEEE Electrical Insulation Society, New York
Senat von Berlin
Siemens AG, Berlin/München

At each conference a particular individual is honored for his contributions to the field and to this series of conferences. This year's invited lecture is due to Dr.E.O.Forster, who reviews the topic of breakdown of liquid hydrocarbons.

Thanks are due to many more people than can be expressed individually who contributed to the preparation of the 7.ICDL.

W.F.Schmidt
Berlin, July 1981

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Radiation Induced Conductivity,
Geminate Recombination

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THEORY OF TIME-DEPENDENT GEMINATE RECOMBINATION

J. Noolandi

Xerox Research Centre of Canada, 2480 Dunwin Drive,
Mississauga, Ontario, Canada, L5L 1J9

The solution of the Smoluchowski equation,

$$\frac{\partial \rho}{\partial t} = D \operatorname{div}\left(e^{-W} \underset{\sim}{\nabla} \left[e^{W} \rho \right] \right) \quad , \tag{1}$$

where

$$W = - (r_c/r + 2 F\mu r/r_c) \tag{2}$$

is the potential energy divided by $k_B T$, μ is the cosine of the polar angle between the electric field $\underset{\sim}{E}$ and the radius vector, r_c is the Onsager radius[1], and F (dimensionless) is defined by

$$F = eEr_c/2k_B T \ , \tag{3}$$

is important both in solid state physics and in radiation chemistry. Recently we have obtained the time-dependent analytical solution of this equation[2] (also known as the Onsager problem), and in this paper we review some of the properties of the solution, and discuss interesting applications.

The details of the rather lengthy analytical expressions are given elsewhere[2]. Here we wish to concentrate on the singularity structure of the solution in the complex Laplace transform plane, shown in Fig. 1. The remarkable feature in this structure is the appearance of an infinite number of poles for F greater than a critical value $F_c \simeq 1.27863$, with the limiting point the branch point at $-(F/2)^2$. While the shifted branch cut along the negative real axis is expected for a diffusive wave packet moving with a constant velocity, the existence of the discrete poles is surprising. A simple interpreta-

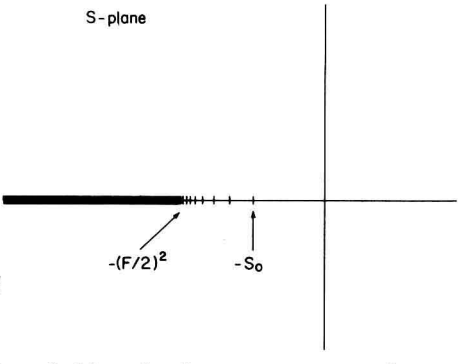

Fig. 1 Singularity structure of solution to time-dependent Smoluchowski equation in Laplace transform plane. Poles appear from branch point for $F = Er_c/2k_B T > 1.27863$.