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Book Review: *Stochastic and Dynamic Views of Chemical Reaction Kinetics in Solutions*

Stochastic and Dynamic Views of Chemical Reaction Kinetics in Solutions. Alexander M. Kuznetzov. Presses Polytechniques et Universitaires Romandes, Lausanne, 1999.

Although very many chemical reactions occur in solvents there are few books on the subject written from the point of view of statistical mechanics. The book by Kuznetzov, to some extent, contributes to providing a remedy of this lack. This book consists mainly of material used by the author in a series of lectures to final year and graduate students in the École Polytechnique Fédérale de Lausanne on the stochastic theory of chemical reactions in the condensed phase. Since the course was designed to be an introductory one, the author stimulates an understanding of this complex subject by means of simplified models and analogies to more familiar physical systems.

The development of a comprehensive theory of chemical reactions in solvents in the framework of statistical mechanics poses an extremely complicated many-body problem. The overall problem has several aspects which have traditionally been considered independently. The first of these is how to model the collisions or encounters of reactants moving in the solvent. A second one is that of modeling chemical transformations of reactants that are in close contact. The latter is usually split into two parts: 1. A derivation of the stochastic equations of motion for a few relevant degrees of freedom responsible for the chemical transformation. This must take into account the dynamical behavior of both the reactants and the solvent. 2. An analysis of the stochastic equations of motion with the goal of calculating the rate constants to be used in standard equations of chemical kinetics. Kuznetzov's book is mainly concerned with the second of these steps.

More specifically, the main part of the book is devoted to outlining the theory of electron-transfer reactions in polar solvents and the related

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subject of proton-transfer reactions. Here, to calculate a rate constant one has to analyze tunneling of a quantum particle through a fluctuating barrier. The book also contains several chapters on Kramers' theory of reaction rates which describes the escape of a classical particle from a deep potential well due to interaction with a thermally fluctuating environment modeled as a heat bath.

The book consists of 18 chapters as well as 14 short appendices providing details of some of the calculations. The brevity of the book will be sure to appeal to readers interested in gaining an overview of the subject. The first three chapters give a descriptive introduction to some elements of the theory of stochastic processes used in the subsequent theoretical development. The remaining chapters contain an analysis of a number of stochastic models leading to a qualitative picture of the reaction event together with approximations useful in deriving expressions for the macroscopic rate constant.

Different groups of investigators have used a variety of approaches to develop the theory of chemical reactions in solvents. It is clearly impossible to give comprehensive coverage of all of them in a short and introductory book. However, I believe that this book provides a useful introduction to the general subject for students and researchers.

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