Preface

CHEMISTS DO EXPERIMENTS and make calculations of isotope effects in chemical reactions and in photodissociation processes. Other scientists are using knowledge of isotope effects to better understand complex physical and chemical systems, such as the earth's atmosphere, planetary atmospheres, and interstellar space. This book brings them together and showcases some of the recent developments in the area of isotope effects. Some of these developments have been pursued in related disciplines; results have been published in journals, such as the *Journal of Geophysical Research* and *Geophysical Research Letters*, that are not necessarily standard reading material for the more traditional chemistry community. The material in this book crosses a number of boundaries—experiment–theory, neutral–ionic systems, very small–intermediate-size systems, and basic science–applications. The only restriction is that consideration is limited to gas-phase processes.

Several interesting issues are described both in the overview chapter and in the individual chapters in this volume, but it is worth pointing out some that receive particular emphasis.

1. The observation that three-body recombination of O and O_2 in the laboratory preferentially forms isotopically heavy O_3 in a mass-independent manner that appears to be related to molecular symmetry and is undoubtedly related to the observation of enhanced heavy O_3 (mass 50) in the earth's atmosphere. The enhancement in the laboratory is surprisingly large (10–15%) for a heavy-atom isotope effect. Other large heavy-atom isotope effects have since been reported and are discussed.
2. The interest in accurate knowledge of the isotope effect in the reaction of OH with CH_4 (both for ^{13}C and D substitution) for the range of temperature appropriate to the earth's atmosphere.
3. The ability to calculate accurate primary and secondary isotope effects for simple chemical reactions by using variational transition-state theory.
4. The ability to measure directly and to calculate the branching between D- and H-atom production in the photolysis of molecules containing both.

In Isotope Effects in Gas-Phase Chemistry; Kaye, Jack A.;
ACS Symposium Series; American Chemical Society: Washington, DC, 1992.

Scientists from the United States, Canada, Israel, Denmark, and Germany contributed to this book. Among them, Susan Graul received the Division of Physical Chemistry's Nobel Laureate Signature Award for Graduate Studies in Chemistry.

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Although he was unable to submit a chapter to this book, I would like to acknowledge the contribution to the field of isotope chemistry made by Professor Aron Kuppermann of the California Institute of Technology. Besides serving as the thesis advisor for several of the contributors to this book (Bowman, Garvey, Kaye, Schatz, and Truhlar), he has made numerous important contributions to the field of chemical dynamics that have helped in better understanding isotope effects in chemical reactions.

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