Carbon-Functional Organosilicon Compounds

MODERN INORGANIC CHEMISTRY

Series Editor: John P. Fackler, Jr.
Texas A&M University

METAL INTERACTIONS WITH BORON CLUSTERS
Edited by Russell N. Grimes

HOMOGENEOUS CATALYSIS
WITH METAL PHOSPHINE COMPLEXES
Edited by Louis H. Pignolet

THE JAHN-TELLER EFFECT AND
VIBRONIC INTERACTIONS IN MODERN CHEMISTRY
I. B. Bersuker

MOSSBAUER SPECTROSCOPY
APPLIED TO INORGANIC CHEMISTRY
Edited by Gary J. Long

CARBON-FUNCTIONAL ORGANOSILICON COMPOUNDS
Edited by Václav Chvalovský and Jon M. Bellama

Carbon-Functional Organosilicon Compounds

Edited by

Václav Chvalovský

Institute of Chemical Process Fundamentals
Czechoslovak Academy of Sciences
Prague, Czechoslovakia

and

Jon M. Bellama

Department of Chemistry
University of Maryland
College Park, Maryland

Plenum Press • New York and London

Library of Congress Cataloging in Publication Data

Main entry under title:

Carbon-functional organosilicon compounds.

(Modern inorganic chemistry)
Includes bibliographical references and index.
1. Organosilicon compounds. I. Chvalovský, Václav. II. Bellama, Jon M., 1938–
III. Series.
QD412.S6C37 2984 547'.08 84-3438
ISBN 978-1-4757-0383-2 ISBN 978-1-4757-0381-8 (eBook)
DOI 10.1007/978-1-4757-0381-8

Softcover reprint of the hardcover 1st edition 1984

A Division of Plenum Publishing Corporation
233 Spring Street, New York, N.Y. 10013

PREFACE

The term "carbon-functional organosilicon compound" is used for organosilicon compounds in which a functional group is bonded to an organic moiety that is in turn connected to silicon via a Si-C bond. Thus, only $Si-C_n-Y$ compounds (Y designates a functional group) will be discussed in this book; $Si-O-C_n-Y$ compounds will in general not be considered, although the latter group does include a large number of natural substances containing silylated hydroxyl groups. (Because of the differing importance of various Y groups, the reader will find some deviation from this restriction). Finally, compounds containing a silyl group as the functional group are not considered.

An overview of the field of organosilicon chemistry would show that in the last several decades the commercial synthesis of organosilicon products has increased substantially, both in annual production and also in the increasing variety of compounds produced. This increase in the number of commercially available carbon-functional monomers and polymers (silicone polymers) is most remarkable and is occurring because new applications are continually being found for these compounds.

As might be expected, the number of publications in this field is also increasing. The important position of silicon in the periodic table - between carbon, aluminum, and phosphorus - means that an understanding of the nature of the bonds in organosilicon compounds is quite important in order to understand the bonding in these other areas. In general, silicon compounds can be readily prepared, and most of them are relatively stable; thus, it is possible by comparing analogous organic and organosilicon compounds to draw some general conclusions concerning the effects of the comparative electropositivity, the greater atomic volume, the potential utilization of vacant orbitals, or the higher polarizability of silicon.

The purpose of this volume is to provide information about carbon-functional organosilicon compounds from four different viewpoints, each of which will be useful to industrial research and other scientific workers.

The first chapter considers the practical applications and uses of carbon-functional organosilicon compounds (1) in laboratory procedures of organic chemistry and biochemistry, and (2) in production of composite materials from plastics and resins containing inorganic fillers. Although carbon-functional silanes also have begun to find application as regulators of living processes, only basic data on the biological activity of silanes are reported in this chapter. This topic has been recently reviewed [1] in a special volume of the series "Topics in Current Chemistry".

The effects of intramolecular interactions on the chemical properties of carbon-functional organosilicon compounds are treated in Chapter 2. This general interpretation will be of interest to the reader interested in the utilization of silanes in synthesis.

Chapter 3 summarizes the effects of structure on the NMR spectral parameters of carbon-functional silanes and provides information about (1) the interpretive power of NMR in the study of the structure of these compounds, and (2) the nature of their intramolecular interactions. The first part of the chapter briefly considers ^{29}Si NMR spectroscopy and gives information that is required for a better understanding of this specialized field. For a more detailed treatment the reader is referred to recent reviews [2,3].

In Chapter 4, the goal is to discuss from a theoretical point of view the effect of structure on the properties of organosilicon compounds. The review does not duplicate the recent review by Kwart and King [4].

Finally, we would like to thank Professor R. Zahradnik (J. Heyrovsky Institute of Physical Chemistry and Electrochemistry of the Czechoslovak Academy of Sciences) for valuable comments and suggestions.

References

[1] Tacke R., Wannagat U., Voronkov M.G.: Bioactive Organo-Silicon Compounds. Berlin-Heidelberg-New York: Springer (1979).
[2] Schraml J., Bellama J.M.: ^{29}Si-Magnetic Resonance in the Determination of Organic Structures by Physical Methods, Vol. 6. New York: Academic Press (1978).
[3] Kintzinger J.P., Marsmann H.: Oxygen-17 and Silicon-29 in NMR-Basic Principles and Progress, Vol. 17. Berlin-Heidelberg-New York: Springer (1981).
[4] Kwart H., King K.G.: d-Orbitals in the Chemistry of Silicon, Phosphorus and Sulfur. Berlin-Heidelberg-New York: Springer (1977).

CONTENTS

ABBREVIATIONS

Ar	aryl
E	electrophile
Et	ethyl
M	metal
Me	methyl
Nu	nucleophile
Ph	phenyl
R	alkyl
R^X	alkyl substituted by X in β-ω position to silicon
X	electronegative or unsaturated group
Y	halogen
Δ	heat