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Book reviews

Atomic and Molecular Clusters; edited by E.R. Bernstein, Elsevier Science Publishers, Amsterdam, 1990, 806 pages, Dfl. 495.00, $253.75. ISBN 0-444-88193-X.

The study of clusters has come a long way since the initial observation of "magic number" atom combinations just ten years ago. The very rapid advances made in the subject owe as much to developments in technology as they do to the ingenuity of the practitioners. As the Editor of this Volume notes, the supersonic expansion nozzle and to a lesser extent the laser have been responsible for the very rapid progress made in cluster research. As far as chemists are concerned, this series of review articles samples the breadth of the subject, with discussion ranging from the identification of physical state (i.e. are clusters solid- or liquid-like?) through to the chemical reactions of metal clusters.

The volume begins with a very timely review of carbon cluster chemistry by Smalley. Recent developments (?) in techniques for preparing C_{60} and C_{70} could mean that much of the gas phase chemistry discussed in this chapter may now be possible in a test tube. We could soon see the first commercial application emerge from ten years of comparatively pure research on clusters. The theme of reactivity is continued in Chapter 2, where Mandich and co-workers give a very comprehensive survey of the chemistry of metal clusters. This work embraces another popular topic in cluster science namely the relationship between a cluster (which is all surface) and the reactive/catalytic properties of a surface of the bulk material.

At this point the volume appears to change direction, with the remaining chapters devoted to the physical properties of what might be classified as van der Waals dimers and clusters, i.e. weakly bound collections of closed-shell atoms and molecules. A short, but comprehensive catalogue of microwave and infrared data on dimers and trimers, such as $(HF)_2$ and $Ar_2 \cdot HCl$, is given in Chapter 3 by Klemperer and co-workers. Unfortunately, the length of the article does not do justice to the very considerable intellectual effort made (often by the authors) both to devise the experiments and to analyse the data for the ca. 250 listed complexes. Infrared spectroscopy is continued in Chapter 4 by Watts, where a discussion of the technique and its application to the study of larger clusters is presented. It is at this point that consideration is given to the relationship between clusters and the bulk material, in terms of such factors as frequency shifts, hydrogen bond formation, and the development of microcrystalline structure in embryonic solids.

The next three chapters address the subject of electronic transitions in weakly bound clusters. For a cluster of the type $Ar_n \cdot I_2$ we might expect the inert gas component, at the limit of large n, to act as a matrix. Thus, the work reviewed by Janda and Bieler on the photochemistry of inert gas–halogen complexes has implications for the development of solvent shifts in matrix isolation spectroscopy. At the same time, the article discusses some of the interesting quantum effects these small complexes exhibit when photodissociated.

One experimental technique that has undergone a quite dramatic revival in the

past five years is time-of-flight mass spectrometry (TOFMS). In the search for transient clusters the multiplex advantage offered by TOFMS is extemely useful. It is nice to see, therefore, that in Chapter 6, Keesee and Castleman give an overview of the technique. In particular, they discuss the refinements that have been made to TOFMS in order that fragmentation steps within the apparatus may be identified and put to use in the analysis of chemical reactions in clusters. A brief survey of results from specific cluster systems is also given.

In a very extensive article Bernstein (the editor) presents a comprehensive review of the visible and UV spectroscopy of organic solute–solvent clusters. Of particular value is the interpretation of frequency shifts in terms of the intermolecular interactions that exist between the constituent molecules. If nothing else the bulk material and the clusters must share the same potential energy surface and so the results from the type of experiments described by Bernstein are of value to those interested in the computer simulation of bulk liquids and solids. In the final chapter Whetten and Hahn review some of the spectroscopic tech ques that have been used to study clusters ranging in constitution from Ar_n^+ through to $(CH_3OH)_n \cdot Cs^+$. Given the contens of the previous chapters it may seem that ther is not much else to cover, but in fact the article provides some fresh ideas and insight into the types of problems in cluster physics that we might wish to tackle over the next ten years.

Viewed as a whole the book provides an extensive survey of current research in clusters, with each article having been prepared by an acknowledged expert in the field. It is unfortunate, therefore, that at $253.75 the work is unlikely to be purchased by those most likely to benefit from its contents.

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Transition Metals in Total Synthesis; by P.J. Harrington, John Wiley and Sons, New York, 1990, xvi + 484 pages, £47.50; $71.95. ISBN 0-471-61300-2.

The extent to which organo-transition metal chemistry has been used in organic synthesis has increased substantially over the past decade. A number of syntheses have been reported in which the application of an organo-transition metal reagent has allowed a synthetic step to be used which possesses an unusual regiospecificity thus permitting a novel synthetic strategy to be developed. It is therefore important that the power of these methods is incorporated into the armoury of the synthetic organic chemist.

This book takes twenty biologically important molecules and explores the way in which organo-transition metal chemistry has been used in key steps in their synthesis. Each chapter begins with an outline of the importance of the compound concerned and then describes in general terms the principles involved in the use of the organo-transition metal reagent before the syntheses themselves are discussed in detail. Each chapter is well referenced. The text is organized by metal. Thus chapters 2 and 3 describe applications of organopalladium chemistry whilst chapters 4–6 cover three areas of organoiron chemistry. Chapters 7–10 are devoted to aspects of cobalt-alkyne chemistry. Chapters 11–13 describe areas of organochromium and titanium chemistry whilst the final chapters review some advances in