The Group 13 Metals Aluminium, Gallium, Indium and Thallium

A book about the peculiarities of group 13 metals? This seems a bit fancy. But looking back 20 years, textbooks were limited to the chemistry of aluminum and gallium in oxidation state +III. Gallium was described as having a behavior similar to that of the homologue aluminum. The heavier congeners were treated briefly, and the pronounced stability of metal(I) cations was mentioned. Since then, a lot has happened; new developments during the past two decades have led to a renaissance in main-group chemistry. This book sets out to describe those developments for the elements aluminum to thallium.

It starts with a concise overview of developments in the chemistry of group 13 metals, and a brief description of methods leading to new classes of compounds. An interesting discussion about small molecules, isolable only under matrix conditions, is an important part of this chapter. The discussion covers a wide range of oxidation states, from the usual +III to −I, where non-integral numbers are also possible, at least formally.

The corresponding structures display an impressive variety. Also, the chemical behavior in the classical oxidation state +III allows chemistry of a broadly coordination kind through the acidity, which leads to applications in organic synthesis and to solid-state compounds that are valuable semiconductor materials, and to other applications.

Therefore, the first main chapters deal with compounds of these triel elements in oxidation state +III, first with simple inorganic compounds, and then with organometallic compounds. These chapters give a beautiful and useful overview of the various classes of compounds and their reaction pathways.

Those chapters are followed by a description of the chemistry developed in the past 20 years, dealing with compounds of aluminum to thallium in oxidation state +II. The authors explain the variety of simple ditrielanes E_2R_4 and show how to align several of those E_2 units in one molecule.

Next there is a discussion of compounds with triels in oxidation state +I. The chapter describes methods for the stabilization of monomer derivatives, which was achieved successfully only a few years ago, and their aggregation to form clusters. The behavior of monomers ER, which have Lewis basic properties due to the lone-pair at the triel atom as well as Lewis acidic properties, is discussed by describing their reactions with transition metal fragments and their oxidative addition reactions.

Logically, the availability of various oxidation states should allow the combination of those in one molecule. The next chapter gives an overview of how to build bonds between different triels, and discusses multiple bonds in metallo-aromatic and unsaturated oligo-triel compounds.

The long chapter on metalloid aluminum and gallium cluster compounds ends the part on less common oxidation states. Following a discussion about various cluster types, the chapter describes methods that have led to a fascinating structural variety of such metalloid clusters—meaning metal-rich and substituent-poor clusters—in the past few years. Connected with these compounds are properties that allow the transition from molecules to metals. This is apparent in the structures that represent sections of metal structures, as well as in the discovery of superconductivity for crystals of those clusters. Al_{77} and Ga_{84} clusters are among the largest molecules that have been structurally characterized.

Returning now to oxidation state +III, solid-state properties are discussed. Examples are ion exchange and inclusions in zeolite-type structures.

The behavior in solution, which has been little studied, is the starting point for biological and medical aspects of triel compounds, such as their use as tumor markers. The environmental characteristics of the triels are increasingly important because they are used in mass products. III/V semiconductors are one of the major modern applications. The preparation and properties of such compounds are described in a separate chapter. The use of these compounds in mass products such as cell-phones and blu-ray players underlines the necessity to understand and evaluate the environmental behavior of the elements and their compounds. The increasing role of triel compounds in organic synthesis, which extends beyond the use as Lewis acids, is discussed in the last chapter.

All the chapters in this book are written by leading experts in the corresponding research areas and offer an excellent overview of recent research. The nearly exhaustive collection of literature references reflects the state of the art up to 2009, or even 2010. The opus is a real mine of information for everyone interested in modern chemistry, for researchers, and for advanced students. Even those who have been active in triel chemistry for years will find this to be a very valuable reference work.

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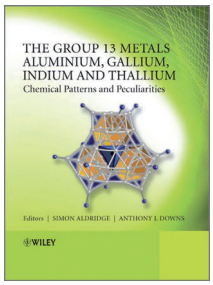

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